A REVIEW OF ACTIVITIES OF CFTRI EXPERIMENT STATIONS

(1964 - 1984)

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APRIL 1985

CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE
MYSORE 570013

PREAMBLE

During the year 1962, the Central Food Technological Research Institute set-up Regional Research Stations in different parts of the country to carry the message of its research and development for the benefit of the different states and also feed back information for renewed developmental activities. Soon after the Project-oriented system of research and development was introduced in 1964, the Regional Research Stations were transformed into Experiment Stations with the specific role of ascertaining the food resources in various parts of the country and also rendering assistance in agro-based food industry development of the country.

The Experiment Stations undertook programmes of research and development, extension and liaison on the subject of post-harvest technology of foods to complement and orient the work carried out by the main complex at CFTRI, Mysore to suit specific regional needs. The brief review presented in this compendium attempts to give an insight into the R&D efforts of the various Experiment Stations and also their expertise generated by them for serving the country in the area of food industry development.

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I EXPERIMENT STATION BOMBAY

WORK DONE AT CFTRI-EXPERIMENT STATION, BOMBAY SINCE 1961

1. Name of the Laboratory/ Institute:	Central Food Technological Research Institute
2. Name of the Centre/Unit	CFTRI Experiment Station
3. Location of the Centre/ Unit:	Bombay
3.1 Full Address:(including Telephone, Telegraph and Telex)	CFTRI Experiment Station Bhavan's College Campus Andheri (West) Bombay-400 058. Telephone: Office 571599 Residence 6326721 Telegram: FOODSEARCH, ANDHERI BOMBAY-400 058 Telex: Nil
4. Whether the unit located in own or hired accommodation:	Located in hired accommodation
5. Approved by	EC: Yes GB: Yes
6. Date of approval	EC: .. GB: March 1959
7. Date of establishment:	May 1961

8. Justification for setting up of the Unit:

To cater to the need of the fruit and vegetable preservation industry based on the regional fruits and vegetables. Government of India realising the needs of the industry approved establishment of regional stations for conducting research on fruit and vegetable preservation. The detailed programme relating to the establishment of the regional stations was discussed at a number of meetings organised by the Ministry of Food & Agriculture and the Fruit and Vegetable Development Committee of ICAR. Arising out of the above, the Ministry of Food & Agriculture communicated to the Ministry of Scientific Research & Cultural Affairs the decision that the Regional Stations (subsequently named as Experiment Stations) would function under CSIR

through Central Food Technological Research Institute.

9. Functions and responsibilities:

To work on raw materials of the region by

i) Extension of processes and developed products of Institute to various parties in the region. This will make available readily the technical know-how and the information needed by the interested parties in the regions. Link with rural agencies and State Government will also be effected.

ii) Techno-economic survey of the available raw material (fruits, vegetables, cereals, pulses, spices, meat, fish and poultry etc.) and the industries of the region.

iii) Attending to the technical problems of the industry in the region.

iv) Technical assistance to manufacturers of the region so as to enable them to produce quality goods.

v) Carry out investigational research on various problems of the region.

vi) Operational research to improve efficiency of industry.

vii) Collection and identification of problems for research.

viii) Research & Development

ix) Liaison with food industries and Government Agencies concerned with the food industry.

x) Undertaking technical consultancy.

10. Linkages with local agencies (and their nature):

1) Department of Industry: Yes

- Participating as a Member of R&D Committee of State Level for Food Industries.

2) Universities and higher centres of learning: Yes
- Technical Member in the SNDT University.

3) Local Industries: Yes
- Consultant to MAFCO Ltd.

4) Others (Specify):- Technical advice to cottage and small scale industries for improvement of their products.

11. Areas of specialisation of the Unit:

a) Fruit and Vegetable Technology

b) Extension/Demonstration of CFTRI Processes

12. Activities in which the Unit is engaged:

Demonstration
Analysis
Dissemination
Surveys
Consultancy
Research(applied)

13. Nature of activities in brief:

1. CANNING OF SUITABLE VARIETIES OF MANGOES GROWN IN MAHARASHTRA AND GUJARAT FO R CANNING PURPOSE:

In Maharashtra and Gujarat many varieties of mangoes are grown. Studies were undertaken to screen the suitable variety of mangoes in six varieties for canning purpose, namely Totapuri, Dilpasant, Alphonso, Rajapuri, Malgoba and Dadamia, for its average peel, stone and slices for the purpose of canning. It was observed that Alphonso, Malgoba and Totapuri were found suitable for canning.

2. DEHYDRATION OF GRAPES, MANGOES & BANANA:

Selection-7 and Bangalore purple varieties were tested for dehydration. Checking of fruits was accomplished best by steeping them in 0.6% Na_2CO_3 solution

at 95-100°C for 20 seconds. For Bangalore purple grapes steeping in 0.6% NaoH solution proved more suitable for checking. The berries of early season were steeped in syrup of 40° Brix containing 0.2% KMS for 48 hours to raise the brix to 20°. Sulphuring was done (2 g/kg.) for 45 minutes. The fruits were then dehydrated. The dried product (raisins) had a shelf life of 4 months but became sticky thereafter. Syruping of low sugar fruits was not advantageous.

The checked barries were dried for 24 hours: for the first 2 hours at 80°C and subsequently a t 60°C the yield was 20%. Smearing with paraffin oil after 22 hours of drying made the raisins free flowing.

The raisins stored well in metallic screw-capped glass jars for more than a year, they were accepted in the Bombay market but could not compete with exotic varieties because of seeds.

The dropped berries, estimated at 10% of the harvest could be economically dried only by partial drying in the cabinet and subsequent sun drying. But the manufacture of raisins from fresh grapes is not possible at present due to high cost of the fresh grapes and ready market available in big cities. At present most of the grapes grown in our area are having total TSS between 13-18% which does not give good raisins. It is necessary to undertake study to increase the sugar content of the present varieties to 22-24% TSS, so that they can be suitably dehydrated in good raisin. As most of the grapes grown here are seeded and cannot be made into "Kissmiss", which is a good table raisin imported to this country.

Dehydration of Mango: Among the varieties tried, Alphonso proved to be suitable for dehydration. The slices,

cubes and chunks were steeped in syrup of 30°brix for 2 hours for improving the texture of the final product. Sulphuring (2 g/kg.) was done for 2 hours for chunks and 1 hour for slices and cubes. Longer period of sulphuring imparted SO_2 odour. At a temperature of 65°C the chunks took 14 hours and the slices and the cubes 7 hours for dehydration to attain a moisture content of 18%.

The product had satisfactory taste and texture and could be stored in polythene bags for 6 months at 55°F.

Dehydration of Bananas: Rajeli was the most suitable variety for dehydration among the bananas grown in Mahatrashtra. The bananas were peeled and steeped in 2% KMS solution and 0.5% NaCl solutions. They were then sulphured (2 g/kg.) for 2 hours and dried. About 35 hours at 60°C were necessary for Rajeli variety to dry to a moisture level of 17% in the final product (yield 35-40%). The products from Rajeli variety has good flavour and texture while those from other varieties were starchy. In polythene packs the product remained sound for more than a year.

3. THE BANANA GROWERS IN THE AREAS OF BOMBAY AND GUJARAT WERE EDUCATED IN HARVESTING, HANDLING AND PACKING OF BANANAS MEANT FOR EXPORT TO JAPAN AND USSR.

This study was taken at the instance of the Commerce Ministry and the State Trading Corporation of India with a request to standardize conditions for exporting Indian bananas successfully by application of scientific methods in respect of selection of bananas, their harvesting, treating, handling, packing, stacking, transportation and storage. Actual experiments were conducted in the laboratory in the field and during export by sea. The methods were standardized and the shipments of bananas varying between 600 to 1000 tonnes reached the destination in good condition with acceptance level

rising to 96% from the earlier 50%. In this project, the problems were identified at every stage of operation and their solutions were attempted in scientific manner. This experiment stations role in this project was to plan the experiments, conduct transportation and storage studies, train personnel in selecting fruits of particular ma-turity and other handling, plan the operations during the actual export and supervise the harvesting, handling, treating, packing, stacking, and storage temperature, both in the growing centres and at the time of export at the port. The above work was carried out with the collaboration of Headquarters.

4. USE OF PROTEIN ISOLATE AS PART OR WHOLE REPLACEMENT OF MILK IN BURFI LIKE INDIGENEOUS SWEET PREPARATIONS:

In Bombay alone 2.5 tonnes of Khoa is coming every day from Gujarat for manufacture of traditional Indian Sweets. On this basis 900 tonnes of Khoa are consumed every year in Bombay. The replacement of Khoa with protein isolate at 10% level can save 90 tonnes of Khoa annually in Bombay alone. The cost of Khoa ra nges from Rs.6 to Rs.9 per kg., while the cost of protein isolate is Rs.5.60 per kg. As the replacement of 10% Khoa by protein isolate is possible the industry can save Rs.1,80,000 per annum in Bombay alone. Further, this will increase the protein content of the product by 6% level.

5. DEMONSTRA TION AND EVALUATION OF INFESTATION CONTROL TECHNIQUES ON SELECTED COMMODITIES TO WORK OUT COST/BENEFIT RATIO:

A survey was undertaken to collect information on the present storage conditions of agricultural commodities in the commercial warehouses in Bombay. The commodities were stored in Government owned and private

godowns. The number of godowns were inadequate and space was limited, hence the traders adopted mixed storage of various commodities. This caused congestion and overcrowding of bags and pest control operations were rendered difficult. Only a few traders adopted pest control measures. The existing storage structures were studied in detail and observations made on the commodities received in the market. High cost of godown structures in the main marketing centres, lack of funds and exhorbitant rent force the traders to neglect the normal sanitation of the godown and pack it to the fullest capacity.

Observations were made on the condition of storage, period of storage source of infestation and marketing practices. Samples were drawn and analysed. A total of 126 samples of pulses and wheat were collected. 31% of them were found infested. Infestation was found to be 25.3% in pulses and 41.2% in wheat. After two months of incubation infestation was found to be 33.8% in pulses and 65% in wheat. It was noticed that Kabuli Gram, Chawli, Val, Vatana White and Wheat suffered maximum damage after 2 months of storage.

6. STUDIES ON THE METHOD OF STORING PULSES IN BOMBAY:

A survey was undertaken to study the method of storing pulses in Bombay. Pulses constitute a major portion of the commodities imported to Bombay market from various parts of the country. It is estimated that on an average about 2.2 million bags of pulses are received in Bombay. These are stored for varying lengths of time until consumption in Bombay or elsewhere. Preliminary studies conducted on pulses have shown that there is damage to commodities due to lack of proper storage conditions. This enabled us to study the various aspects of storage of pulses in Bombay Market.

Following studies were undertaken.

1. Study of the various aspects of the pulses imported to Bombay, which is the terminal market of these commodities

2. Study of the extent of damage caused to the pulses during transportation and storage

3. Study of the different methods of storage of pulses in Bombay and to evaluate their relative merits

4. To guide the merchants on proper methods of storage of pulses and to give technical guidance.

Main findings of the research: The pulses are imported to Bombay from various places of Maharashtra, Rajasthan, Gujarat, Punjab, Madhya Pradesh and Uttar Pradesh. In 1973 about 1.5 million tonnes of pulses were imported to Bombay. A survey was undertaken of the various godowns where the pulses are stored in Bombay Market.

Impact of research results on the industrial development: The merchants have been made aware of the magnitude of damage in cases of pulses due to improper storage practices.

7. ANALYSIS OF FRUIT & VEGETABLE PRODUCTS:

The project was undertaken to study the quality of fruit products which are marketed internally and for export purposes. The involvement in this study has given an idea of different types of varieties of the fruit and vegetable products which are exported from this region. This has given us an opportunity to solve many problems of the fruit and vegetable industry for improving the quality of their products. This has further given an opportunity to have a liaison contact with the industry to suggest some of the improved products of our Indian

tradition, which is now being exported.

Specifications and Standards have been laid down under FPO (1955) for commercial manufacture of fruit & Vegetable products. Considering the delay in the transit of samples and the urgency in getting the results, the analytical work was undertaken at Bombay.

Every year on an average of 9000 samples were analysed at Bombay Experiment Station and results were conveyed to the Director, F&VP., New Delhi.

8. SURVEY OF AFLATOXIN CONTENT OF UNREFINED GROUNDNUT OIL IN MAHARASHTRA AND GUJARAT:

The above project was undertaken with the collaboration of Headquarters. The explanatory studies carried out at CFTRI, Mysore that about 20% of the toxins present in the groundnut kernel will go with the oil. Thus a survey was undertaken during which various samples of unrefiened groundnut oil from Bombay suburban and nearby areas were analysed for the aflatoxin content.

9. EVALUATION OF INDIGENEOUS TIN PLATE CONTAINER FOR FRUITS AND VEGETABLES:

The above project was undertaken in collaboration with HQs. The purpose of this research project was to study the effect of coastal climatic conditions on the external surface of different variables like thickness of tin coating, paper labelling, lithography cans, during which periodical observations regarding different stages of rusting of external surface were taken on both plain water and brine water filled cans.

10. STUDY OF THE MARKETING OF FRESH FRUITS AND VEGETABLES OF COMMERCIAL IMPORTANCE IN VIEW TO ASSESS PACKAGING, TRANSPORTATIONAL HAZARDS, MARKETING PRACTICES IN BOMBAY WHOLESALE MARKETS (MAINLY, MANGO, GUAVA, GRAPES, TOMATOES, LADY'S FINGER, CABBAGE AND GREEN PEAS):

Preliminary observations have shown that there is

one Wholesale market of fresh fruits and two wholesale markets of vegetables. These perishables are transported by trucks and railway wagons. In Bombay wholesale market, it gets distributed from Trader-Sub Broker-Retailer-Hawker and finally to the consumers in the metropolitan city. It has been observed that various packaging materials are utilized for packaging of perishables such as gunny bags, bamboo baskets, wooden cases, steel trunks and other cheaper materials of various sizes and shapes. In spite of which, due to various defects in packaging, transportation and handling methods causes a large quantity of wastages of fresh fruits and vegetables. Therefore, it was necessary to study the various packaging, transportation, handling problems in depth and evolve the suitable measures for better packaging, transportation, handling of perishables and thereby to minimise the avoidable losses so as to get better returns to the farmer.

The objective of the project is to prevent avoidable wastage of fresh fruits and vegetables by educating the farmers from nearby growing centres, traders and other concerned workers through technical guidance of better and economical methods of packaging, transportation and handling of fresh fruits and vegetables.

It is estimated, that annually, on an average, 6 lakh tonnes of fresh fruits and vegetables are arriving in Bombay Wholesale markets from different parts of the country, and in terms of money its value exceeds 100 crores rupees. Preliminary studies conducted have shown that the magnitude of wastage occuring during different stages of distribution is as much as 20 to 45% depending upon the factors affecting. As such, perishables get deteriorated much rapidly due to

various reasons in the methods of packaging, transportation and handling. It is considered necessary to take up a survey of packaging conditions, transportation and marketing practices of selected fruits and vegetables and to identify the problems involved.

11. HOT WATER TREATMENT OF MANGOES, PARTICULARLY SARDAR & DADMIA VARIETIES OF COMMERCIAL IMPORTANCE GROWN NEAR BULSAR(GUJARAT) - FRUIT & VEGETABLE DISCIPLINE HEADQUARTERS COLLABORATION PROJECT:

This work was carried out at Pardi. There was less spoilage in hot water treatment fruits than the control. Further hot water treatment ripen the fruits earlier in Dadmia while in Sardar there was not much difference. The spoilage in Sardar was 0.8% against 1.6% in Control. In case of Dadmia hot water treated fruits the spoilage was 1.6% against 3.6% in control.

This method of ripening has been appreciated by the processors and have adopted the method.

12. EXPERIMENT ON MANGO PULP/JUICE CANNING ELIMINATING RETORTING STAGE (COLLABORATION WITH DISCIPLINE OF FRUITS AND VEGETABLE DISCIPLINE HQ.)

Canning of mango pulp was carried out at three different factories to save energy while processing. They are

1) M/s. Herbertsons Limited, Bombay
2) M/s. Vasundhara Canning Pvt. Ltd., Pardi
3) M/s. Gujarat Agro Industries, Gandevi (Gujarat).

The filling temperature in cans was maintained at 85 to 90^{o}C, sealed, kept inverted and allowed to cool.

Storage studies had shown that if the temperature is maintained while filling, the canned mango pulp can

remain as good as processed cans. This process saves the energy and some of the processors have put this process into practice.

13. STUDIES ON CHEMICAL, TECHNOLOGICAL AND STORAGE ASPECT OF ONION, PROJECT NO. 674 (COLLABORATIVE PROJECT WITH EXPERIMENT STATION, NAGPUR.):

This experiment was carried out in collaboration with Associated Agricultural Development Foundation, Nasik Road and NAFED.

It was observed that bulbs having 2.5 cm. tops above bulbs, performed better storage life than closed cut bulbs. As regards curing method, leaf cover method and bunch hanging method were found better. The experiment was carried out on Pool (Kharif), Unal (Rabi) and Rangda (Late Kharif) Crops.

Regarding storage study the parameters like microbial spoilage, sprouting, weight loss were studied for five to six months during different seasons in different storage patterns. It was found, tier system is better than the prevalent storage systems.

14. TECHNO-ECONOMIC SURVEY OF INDIAN TRADITIONAL FOODS:

Information about the manufacture like addresses, items of manufacture, capacity and a classified list of items of traditional foods was collected and despatched to IDCS Discipline, CFTRI, Mysore. Preliminary contacts were established for interaction with industry and visits to industries in Bombay.

14. <u>List of papers published</u>:

1) The salient features of Indian pickles exported from Bombay.
2) Assessment of differential Tin Plate for canning processed Food Products.

3) Techno-economic survey on the scope for establishment of Agro-based and Allied Industries.

4) Salient features of fruit and vegetable products exported from Western Region.

15. SURVEY WORK UNDERTAKEN:

1) Information on papad manufacture: A collaborative survey was undertaken with HQs. to collect the information on papad manufacture. The major cities producing paste goods in Maharastra and Gujarat are Bombay, Kalyan, Bassein, Panvel, Poona, Baroda, Ahmedabad, Jamnagar, Bhavanagar and Rajkot. Samples were collected and sent for analysis at HQs. The total export of papad to various countries from Bombay during the year 1971 was 1,32, 708 Kgs. costing Rs.5,08,275/-. These are exported to various countries like Canada, U.K., Uganda, Nigeria, Qatar, Baharin, Kuwait, Tanzania, Kenya, USA, Hongkong, etc.

2) Details of information on various gums produced in India: The major gums which are producing in India are Karaya gum, Ghatti gum and Babul gum. The indigeneous gums such as Karaya and Ghatti are produced in India out of which about 80% is exported to the USA and European Countries.

We produce about 1500 tonnes of Babul gum. Our requirements are 5500 tonnes, hence we import the remaining quantity of 4000 tonnes from Sudan.

3) Survey on the export of fresh fruits and vegetables from Bombay by Air-cargo during the year 1971 and 1972:

A survey was undertaken to study the potentiality of export of fresh fruits and vegetables exported from Bombay. All kinds of vegetables like Lady's finger,

Drumstick, Cucumber, French beans, Green peas, Bitter Gourd, Tinda, Parwal, Guar, Brinjal, Ginger, Green chillies, Corriander leaves, Curry leaf, etc. are exported. The cost of vegetables on F.O.B. is Rs.1.50per kg. for U.K. and Rs.1.75 per kg. for persian Gulf, while fruits are exported at Rs.2.50 to Rs.3.00 per kg. F.O.B. during their seasons. The season of export is September to March.

Total exports of fresh fruits and vegetables during 1971-72 and 1972-73 are as follows:-

	1971-72 April to March	1972-73 April to March
Fresh fruits (including Mangoes)	Rs.35,54,458/-	Rs.55,63,917/-
Fresh Vegetables	Rs.47,60,953/-	Rs.35,87,458/-
Mangoes	Rs.26,08,171/-	Rs.49,47,632/-

4) Survey on problems relating to production and marketing of hard-boiled confectionery.

16. Extension:

1) Number of Industries, Small Entrepreneurs were advised for their difficulties in their products and/set up new industries and technical information on this subject.

2) Use of MPF in the industrial Canteen of TATA Chemicals, Mithapur was demonstrated.

3) Popularising the minifume tablets for preserving the grains from pests in the household was undertaken.

4) Participated in the exhibition organised by Abhinava Sahkar in Bombay for promoting our processes and new products to the industrialists and the public. Demonstration of the manufacture of groundnut curd was given to

Mr. Mulani of Indian Gum Industries, Bombay.

5) Attending the exhibition of food and agriculture at Bhopal for prmoting our processes and new products to the industrialist and the public. Also attended the seminar on Food and Fruit products and the exhibition organised by the Small Industries Service Institute at Ahmedabad.

17. No. of Technical enquiries handled by the Experiment Station:

On an average 150 per year.

18. Analysis of samples:

Party	No. of Samples	
1) Base Victualling Officer, Naval	127	Canned drinking Water
2) IMS Life Saving Appliances, Bombay	186	
3) MAIDC Ltd., Bombay	21	Fruit and Vegetable Products.
4) American Dry Fruit Stores, Bombay	1	
5) Herbertsons Ltd., Bombay	6	
6) Indian Airlines, Bombay	1	

19. Lectures delivered:

1) "Scope of Food items/processes developed by various National Laboratories being processed in the Small Scale Sector".
- at Small Industries Services Institute, Bombay.

2) "Post harvest technology development at National Laboratories"
- at Training College, Reserve Bank of India Pune.

20. Any other item:

1) A get together of CSIR-NRDC and New entrepreneurs was attendedat Ahmedabad. About 600 new Entrepreneurs were guided.about the Processes developed by CFTRI.

2) A meeting arranged by Polytechnological Clinic and Maratha Chamber of Commerce & Industries, Pune, was attended. 100 Members were guided about the scope of food items and processes available with CFTRI.

3) Participated in the survey of frozen fish industry in Maharashtra, Gujarat and Goa in collaboration with IDCS Discipline, CFTRI.

4) A large scale trial run was carried out for the beverage 'Double Seven'. Liaison with the suppliers of raw materials for the above was maintained.

21. Active and live liaison was maintained with various organizations given below:

1) Dr. A.S.Aiyar, Executive Secretary, Protein Foods Association, Bombay.

2) Dr.A.G.Patil, Head of the Department of Horticulture, Mahatma Phule Krishi Vidhya Peeth, Rahuri.

3) Mr. P.R.Bengali, Jt. Secretary, Industries Department Sachivalaya, Government of Maharashtra.

4) Mr. B.L.Purohit, Development Officer (Industries), Industries Commission, Government of Gujarat.

5) Mr. P.N.Mankad, Deputy Director, Fruit & Vegetable Preservation, Ministry of Food, Government of India.

6) Dr.B.V. Nimbkar, Nimbkar Research Institute, Phaltan.

7) Dr. D.V. Rege, Director, U.D.C.T., Bombay.
8) Mr. Naik, Export Manager, MAIDC Ltd., Bombay.
9) Mr. Patil, Research Officer, Mango Research Station, Vengurla.
10) Dr. Zingde, Scientist-in-Charge, NIO Regional Station, Bombay.
11) Dr. S.N. Dwivedi, Director, C.I.F.E., Bombay
12) Mr. Jayakumar, Scientist in-Charge, CSIO Zonal Centre, Bombay.
13) Scientist-Incharge, NEERI Zonal Centre, Bombay.
14) Scientist-incharge, Zonal Centre, (CLRI), Bombay.
15) Dr. G.B.Nadkarni, Head, Department of Bio-Chemistry and Food., B.A.R.C., Trombay.
16) Vice Chancellor, SNDT Women's University, Bombay.
17) Director, IIT., Powai, Bombay.
18) Assistant Director (Foods), KVIC, Bombay.

WORK DONE AT CFTRI-EXPERIMENT STATION, LUDHIANA SINCE 1963

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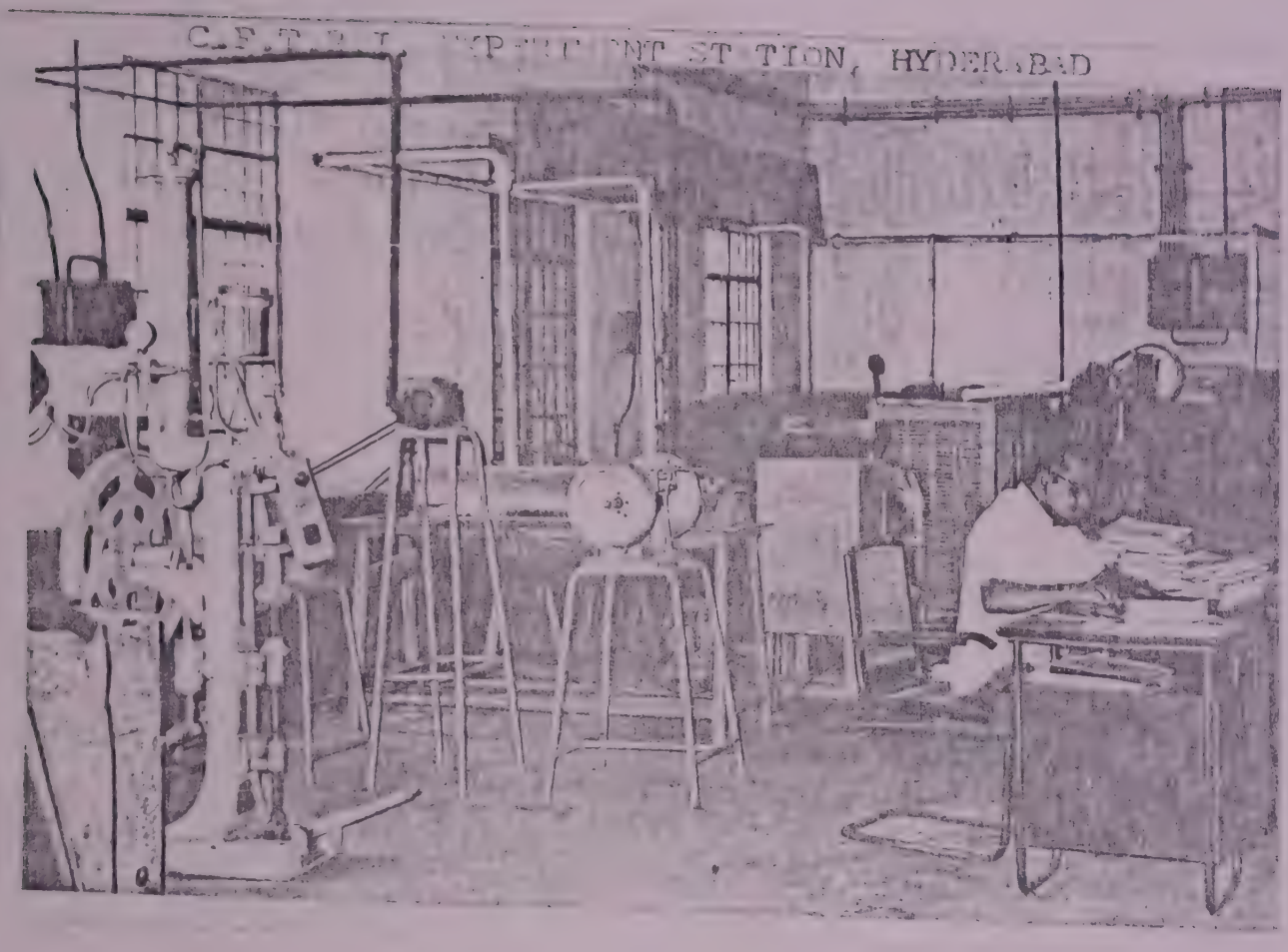
II. EXPERIMENT STATION HYDERABAD


C.F.T.R.I. EXPERIMENTAL STATION, HYDERABAD

WORK DONE AT CFTRI EXPERIMENT STATION HYDERABAD SINCE 1963

I. PREAMBLE:

The Council of Scientific & Industrial Research, in pursuance of the decision of the Planning Commission, approved a scheme in 1962 for the establishment of Regional Research Stations for fruits and vegetables preservation in various parts of the country under the control of CFTRI, Mysore, with the following main objectives:-

i) To conduct varietal trials on fruits and vegetables of the region and to develop suitable varieties for processing purposes in cooperation with the local Horticultural Research Stations.

ii) To conduct investigation on the problems of the industry in the region for expeditious solution and to evolve new products and by-products for economic development of the industry.

iii) To establish closure technical liaison between the food and allied industries as research and also offer advice in the planning and setting up of new factories.

iv) To carry out quality control and F.P.O. analysis work at some of them which are located in important centres.

v) To serve as extension centres for the dissemination of processes and products of CFTRI.

Under the scheme, CFTRI Experiment Station was first started in Andhra Pradesh in February, 1963 at Anantharajupet, Cuddapah District, in the premises of the Fruit Research Station, Government of Andhra Pradesh.

It was initially started with a strength of 8 personnel, consisting of Scientists-B(1), Jr.Sci.Asst.(1), Sr.Lab. Asst.(1), Jr.Lab. Asst. (1), L.D.C.(1), Mechanic (1), Lab.bearer(1) and Watchman (1). After the formation of the enlarged Andhra Pradesh State with Hyderabad as capital, the Centre was shifted to Hyderabad in May,1968, into one of the Industrial Sheds in the Sanatnagar Industrial Estate. Department of Industries (Govt. of A.P.) has alloted the shed No.C-25 in the Industrial Estate free of rent to the Experiment Station. But with the formation of A.P. Industrial Infrastructure Corporation Ltd., in 1971, all the Industrial Estates were transferred to the Corporation by the Govt. of A.P. The Corporation then fixed a monthly rent of Rs.530/- per month for the shed and started collecting rent from 9-5-1971. The Corporation has enhanced the rent to Rs.1,012/-per month with effect from 1-10-1980. As a general policy of the Govt. the shed was offered to CFTRI for out right sale in 1983 by the Corporation. CFTRI has accepted the offer and purchased the building from the Corporation by paying Rs.44,487-91 in March, 1983.

Since the date of its starting, the experiment station was working on various R & D projects, developed some new processes and products and also rendered technical assistance to the local industries and Govt. organisations, by way of supplying project profiles and schemes, conducting demonstration of the developed processes and undertaking quality control analysis of industrial samples. In 1978 the State Government has offered its collaboration to expand the Experiment Station in order to widen the activities of the Centre.

Since then negotiations were going on to finalise the terms and conditions of collaboration with CFTRI. Finally, the State Government has included in its 7th Five Year Plan a scheme to expand the Experiment Station for which Rs.55.0 lakhs were allotted. As the present location of the Centre in the industrial estate is not very congenial for its activities, it is proposed to shift the Station to the Regional Research Laboratory Campus at Taranaka, where a new building can be constructed with the grants from the State Government. The present strength of the experiment station is 12, consisting of Scientist E-1(1), Scientist-C(1), Scientist-B(1) Sr. Sci. Asst.(1), Mechanic (1), Jr.Steno(1), Lab.Bearer (2), Peon(1), Driver (1), Mali (1) and Watchman (1), A brief account of the activities of the experiment station from the date of its starting are given in the following paragraphs:

II. Research & Development Activities:

The following research projects were worked out:

1) Standardising methods for canning tight skinned sweet oranges and comminuted citrus beverages (ES-7/102; Oct. 1963-Oct. 1966):

Methods of canning of tight skinned sweet oranges segments and comminuted citrus beverages were standardised. Sathgudi oranges after harvesting are cured at RT for 1 week , four incisions made round the fruit, blanched in boiling water for 1-2 mts., cooled, peeled, segments removed and then dipped first in 0.25% HCL for about 1 hr. at RT followed by dipping in 0.75% NaOH solution for 1/2 hr. at RT. The peeled segments are washed and canned in 40° Brix syrup containing 0.25% citric acid after exhausting for 15 mts. at 82-85°C,

the cans sealed and processed for 15 mts. at 82-85°C.

For the preparation of comminuted beverages, the citrus fruits are washed, steamed under 15 psi until the centre of the fruit reached 90.5°C, cutting, mixing with sugar syrup (5°Brix of 1/2 to equal weight), comminuting in a fruit mill, screening and bottling with 400 ppm of added SO_2. Beverages are prepared from the base as per the requirements. Only loose-jacketed and sathgudi oranges gave satisfactory products. Acid limes and lemons developed bitter taste, while grape fruit developed off-flavour during storage.

2) Evaluation of mango varieties for canning as slices, juice and concentrate (ES-8/103, May 1966 - Dec.1966).

Eight commercial varieties of mangoes grown in the region were examined to evaluate their suitability for processing. Baneshan and Khader were found excellent for canning of slices. Baneshan was good for nectars. Bangalora is not found suitable due to the development of disagreeable camphorous odour in canned slices and nectar during storage. Addition of Ca (0.04 and 0.06%) to the canned slices did not improve the texture of slices, but impaired the delicate flavour. For juice panchadarakalasa and cherukurasam were found highly acceptable.

3) Optimal harvest time and maturity standards for canning of mango (1967):

In the study it has been established that the maturity of the fruit depends upon the heat units available in the vicinity during the growth and development of the fruit from the stage of flowering, rather than the length of the time between opening of the

flower and full maturity. Thus it was found that 1426±44.8 Centigrade Degree days are approximately needed for Baneshan mangoes to attain full maturity in Koduru area. The heat unit is the difference between the base temperature for mango (18°) C and the mean temperature of daily maximum. Thus it is possible to determine the correct stage of maturity of mangoes at any part of the country. Assessment of maturity by means of visual aids like exudate from stalk, waxy coating, skin colour, dots on the fruit etc. is not dependable as that of heat units.

4) Investigations on the development of a suitable process for the preparation of Vitamin-C rich concentrated beverages from Amla (ES-9/104;March 1964 - March 66):

A process was standardised to get high yield of juice with high Vitamin C content from amlas. The yield of juice varied from 58.0 to 67.7%,depending upon the maturity. Ascorbic acid content varied from 630 to 896 mg/100 g of juice. The decanted juice after storage was concentrated to four-fold to a Brix of 50°, which turned deep reddish brown during storage. The dehydrated whole fruit pulp and the pressed pomace were high in ascorbic acid (1061 mg and 633 mg/100g) and were very light in colour and did not become brown during storage unlike the juice and concentrate.

5) Varietal trials on canning of musk-melons as slices puree and nectar (1966):

Since musk melon is used only as a table fruit and no processing characteristics are available for this fruit, nine varieties of the fruit grown in Cuddapah area were examined for their suitability for canning etc. The prepared fruit cubes were canned in 40°Brix syrup with 0.4% added citric acid. For the preparation of

nectar, the pulp was raised to 15°Brix and 0.5% acidity homogenized, heated to 96°C filled hot and kept inverted. Only Heigan variety was found to be the best for the purpose of canning as cubes. For nectar, the varieties Sherbat anar, Jalbudama, Bathasa and Selection No.7-5 were found best. Addition of Ca to improve the texture has deliterious effect on quality. The ascorbic acid in the varieties varied from 26 to 43 mg/100g.

6) Varietal trials on canning of guavas (1963):

Preliminary trials on canning of different varieties of guavas were conducted. Banarsi, Selection No. 46, Allahabad and Hafsi varities were canned after lye peeling. Lye peeling was uniform and satisfactory in all varieties, except in Allahabad variety due to their corrugated surface.

7) Utilisation of custard apple (ES-30/246):

Preservation of custard apple as processed food was not possible on account of the development of bitterness on heating the pulp above 65°C. Hence different processing techniques were tried to preserve the fruit. The bitter principle was found in the grit and was insoluble in water and highly soluble in alcohol. Enzymatically clarified juice did not develop bitterness on heating and hence can be bottled. Spray dried powder, which was creamy white in colour and almost free from bitterness, was prepared. But the frozen dried sample had slight bitterness. The unheated pulp could be preserved for about 6 months with 1000 ppm of SO_2 and 1.0% acidity, which could later on be made into squash. Liquid fruit, wine and vinegar prepared from custard apples are quite acceptable. Under-matured fruit, if harvested, did not ripen well at RT and became black.

8) Utilisation of mango waste (Ad-hoc:No.72/10):

In order to utilise the enormous waste (40-50%) which come out during mango processing, suitable processes were worked out for the production of edible grade sugar syrup, wine, vinegar and carotenoid pigments from the mango peels and pulper waste, a high grade pectin (220 jelly grade) from the peels and edible grade oil and sugar syrup from the kernels. The sugar syrup, carotenoid pigments and pectin are all used in the fruit processing industry itself as substitute for sugar, as yellow colouring matter and for the preparation of jam and jellies respectively. Mango kernel fat has high demand for the preparation of cocoa butter substitues etc. Thus the entire mango processing waste could be commercially utilised.

9) Field Trials on the Storage of Anab-e-Shai Grapes (Ad-hoc: 72/13):

In order to control the post-harvest disorders in Anab-e-shahi grapes, number of pre and post-harvest treatments were tried. Of all the treatments, the in-package fumigation (IPF) gave the best results by retaining the freshness of grapes for 3 days and reducing berry drop and decay. The maximum berry drop and decay after 7 days at RT in the IPF treated lots were 7.2% and 9.7% against the control 17.3% and 33.1% respectively. This treatment has also completely checked the mould growth on the berries. Next to this, the pre-harvest spray of the bunches with Benolate (250 ppm) + NAA (100 ppm) in water was found beneficial.

10) Screening of some important varieties of mangoes grown in A.P. for their suitability for canning and juice making (ES-50/369):

Nine other varieties of mangoes grown in A.P. viz., Baneshan, Survarnarekha, Jehangir, K.Mulgoa, K.0.7, Sumar-e-bahist x Dasehri, Goa Bunder, Navaneetham and Hyder Saheb were examined to find out their suitability for processing. Baneshan, K.Mulgoa and Suvarnarekha were found to be good for dual purpose of canned slices and juice. Jahangir and K.Mulgoa gave good nectars with respect to the flavour, but had poor colour. Hybrid variety and K.0.7 gave poor quality products due to lack of colour and development of cooked flavour on canning. Others gave moderate products. Addition of Ca(0.02%) to the syrup helped in better retention of colour of the slices, but effected the flavour to some extent.

11) Studies on the preparation of purified papain (Ad-hoc:73/2):

A process for the purification of crude papain was standardised. The initial activity of crude papain which was only 387 milk clotting units per gram, has gone upto 999 m.c.u. on purification and to 1250 m.c.u. on further purification. But the purified papain was found to deteriorate rapidly at RT, while it is quite stable in cold temperature. None of the activators and anti-oxidants tried were found to check the dterioration of the enzyme during storage. Only L-cystiene was found to stablise the enzyme to some extent.

12) Evaluation of standard method of preparation of annatto dye from Bixa-Orellanna Seeds (Ad-hoc:73/18):

Bixa-Orellanna seeds obtained from the Agency area of A.P. were examined for their composition and dye content. A method was standardised for the preparation of crude dye

by alkali extraction of the seeds, followed by the precipitation of the dye with acid and drying. The yield of crude dye by this process was 12.6%of the seeds. Water soluble dye in powdered form was also prepared. Both the dyes were quite stable (86-94%) at 37°C for 2 months. The water soluble colour was found highly suitable for incorporation in food products like mango pulp, toma-to ketchup, biscuits, cakes etc., as colouring matter in place of coal tar dyes.

13) Studies on carotenoid pigments in mango processing waste (Ad-hoc. 74/4):

The peels and pulper wastes of six important commercially processed mango varieties were examined for their carotenoid content. The total carotenoid pigments and carotene were highest in Dusehri peels (13.7 mg and 8.6mg/100g) and in pulper waste (75.mg and 4.5mg/100g). By pectic enzyme treatment, besides getting the clarified juice, practically all the carotenoid pigments were retained in the press out cake, thus facilitating easy extraction of colour from the press cake. A process for the extraction of carotenoid pigments from the peels was standardised.

14) Studies on utilisation of mango peel waste for the preparation of pectin (ES-51/378):

In order to exploit the potentialities of utilisation of huge waste of mango peel for the production of pectin, 22 commercial varieties were examined. It was found that Totapuri and Suvarnarekha peels contained highest quantity of pectin (20-21% on D.W.), Baneshan, Deshri, Badami, Raspuri etc., contained moderate quantity (13-18% on D.W.) while K.Mulgoa, Goa Bunder etc.

contained low quantity of pectin (8-12% on DW). The jelly grade of the pectin from different varieties varied between 160 and 240. A process for the extraction of pectin from peels was standardised.

15. Studies on the utilisation of Sun Flower deseeded heads, seed kernels and leaves of different commercial varieties for the production of pectin (ES-53/445

Since pectin was extracted from Sunflower heads in some foreign countries, studies, were undertaken to examine the different varieties of sunflowers grown in A.P. for their pectin content. The total pectin substances in the flower heads, leaves and stems in the fully matured plants were 21-23%, 7.2 - 8.4% and 5.8 - 6.3 on dry weight respectively. But out of the total pectin present, nearly 70-80% in leaves, 66-70% in stems and 32-36% in the flower heads were of low methoxyl content and therefore of low grade quality. The deoiled seed cake yielded only 6-8% pectin of very low methoxyl content (2.5 - 5.0%). So the locally grown variety of sunflowers were found not suitable for pectin production.

16) Lab. scale preparation and application of Sucrose Esters(Ad-hoc.75/3)

Sucrose esters are the new products entering into world market as non-toxic surfactants for use in a variety of food products. Hence studies were undertaken to standardise a process for their production. In the first step methyl esters of fatty acids were prepared, which were then transesterfied with sucrose to get sucrose-fatty esters. Of the different methods tried fusion technique gave higher yields. The physico-chemical properties of different esters produced were studied.

17) Studies on composition and stability of colour during storage of different varieties of red chillies grown in A.P.(ES-62/476):

Studies were undertaken in order to find out the causative factors for the discolouration in red chillies during -drying and storage. Important commercial varieties (11) of chillies grown in A.P. were examined for capsaicin and capsanthin at various stage of maturity. White patches developed on account of drying of un-uniformly ripened berries. By giving a dip treatment to chillies in a 'DIPSOL' solution before drying, stabilised the colour and also the drying time reduced by about 40%. Retention of capsaicin was also more (11-35%) in the treated pods after one year storage. Poosa Jwala, G-4, Kurakula Mirapa, Red Berry, X-200 and CA-960 varieties contained highest capsaicin content (0.24-0.43%). Varieties G-4, G-5, Warangal, Kurakulamirapa and X-200 contained highest capsanthin content (1.2 - 1.8%. The capsaicin content in the oleoresin extracts was highest in CA-960 and Pusa-Jwala (6.4%).

18) Further studies on prepara-tion of annatto food colours from Bixa-Orellanna seeds (Ad-hoc.77/1):

Since the crude dye prepared earlier was found to contain large proportion of non-colouring matters, studies were undertaken to prepare a refined/purified dye for use in food products. The crude dye on refining gave only 34-36% pure dye, equivalent to 3.0-3.1% of the seeds. Different formulations such as oil, water and acid soluble colour solutions were prepared for multiple uses in food products of broad pH range (2.5 - 7.0).

19) Studies on utilisation of natural plant pigments as food colourants (ES-477):

Methods of preparation of different formulations of annatto dye and concentration of the dye in each were standardised. Suitable assay procedures were adopted to study the dye concentration in the preparations. Application of annatto colour in certain food products was tested successfully. The extraction of carotenoid pigments from mango peels and pulper waste by different methods were tried. The method of P.E. treatment was found laborious and expensive. By drying the peels to reduce the bulk resulted in 50% destruction of carotenoids. Extraction of peel and pulper waste with double solvent system (acetone-hexane) was found satisfactory. The resulting carotenoid paste was made into liquid formulation and tried in squashes/fruit juices as colouring matter, which was found satisfactory.

20) Studies on processing characteristics of Rangpur-limes (Ad-hoc.77/6):

At the request of Agricultural College, S.V. University, studies were undertaken for utilisation of Rangpur limes. Both the green and fully ripened fruits were examined. The Brix and acidity of the raw and ripe fruits were 14.0 and 9.4 and 8.3 and 6.4% respectively. The raw fruits were found suitable for the preparation of oil pickle. Pickle prepared from the salt stock, i.e. slices preserved in brine, was more acceptable than from the fresh fruit. Juice extracted from ripe fruits was found to yield good squash. The products were acceptable even after 1 year storage at R.T.

21) Preparation and evaluation of Sucrose Glycerides (ES-73/629):

Since the preparation of methyl esters using fatty acids is quite expensive, studies were undertaken to prepare sucrose esters directly from the cheaper oils, by-passing the step of methyl esters. Samples of sucrose palmitate and stearate were prepared on lab.scale using sal fat, mango kernel fat, palm oil, coconut oil etc. They are purified to remove the solvents and unreacted constitutents. The HLB values and metling points of different esters prepared varied from 5 to 8 and 37°C to 50°C respectively. The process indicated the feasibility of producing sucroglycerides by a cheaper method employing the technique of direct transesterfication of triglycerides (fats) with sucrose.

22) Studies on correlation of different units of activity of the various grades of Papain (ES-72/628):

Since there are number of quality specifications for the various commercial grades of papain marketed and a lot of confusion exists in assessing the grade of a papain, these studies were undertaken to correlate the activities of papain determined by different methods. For this purpose four grades of papain viz., crude, I.P., B.P.C and Purified were prepared and their activities by the methods of BPC, IP, USP, NF and milk clotting were determined and the values correlated with each other. Except the milk clotting and USP methods to some extent others are not linear in reaction and cannot therefore be correlated directly. However, from the graphs it is possible to assess the quality of a certain grade of papain by all other methods, if its activity by one method is known. These results will avoid the existing confusion in assessing the quality of any grade of papain.

23) Influence of hot-water treatment on the ripening behaviour and control of spoilage in mangoes during storage at ambient temperature:

(All IndianProject of H.Q.)

It is general practice in commerce to pluck mangoes at a slightly lower maturity to withstand the transportation hazards and artificially ripen them at the destination. But the methods adopted for articifial ripening such as smoking, calcium carbide treatment, keeping under hay etc., are not satisfactory. Hence these trials were undertaken to study the effect of treatment on ripening characteristics of mangoes. Two varieties of mangoes viz., Baneshan of A.P. and Dashhri of U.P. while they are still green and hard, were dipped in hot water at 54 ± 1°C for a period of 5 mts. allowed to dry in air and then kept on grass for reipening. The treated fruits ripened uniformly and more rapidly (about 16% more in 8 days) than the control without effecting the organoleptic characteristics and also considerably reduced the spoilage during ripening (4% in the treated lot against 12% in the control in 8 days). The trials were carried out in two seasons and the results confirmed.

24) Studies on Commercial utilisation of Rangpur limes (ES-75/657):

Rangpur limes due to their very high acidity are not used as table fruit. In view of large scale propagation of this variety in the country in future, studies were undertaken to examine the prospects for commercial utilisation of the fruit. Other than the preparation of pickle and squash which was already reported earlier, a good quality cordial was prepared from the fruits.

On account of high yield of juice (49-52%) and its high acidity (6.6 - 8.5%), the juice was found highly suitable for the production of citric acid. The peels on steam distillation yielded about 0.7% oil, which is highly valuable for cosmetics, toilets, confectionery and pharmaceuticals. The peel waste after recovery of oil and drying was found to be a very potential source for pectin production. The dried peels contained 20-22% of pectin of high quality (200-225 jelly grade). Thus the Rangpur limes can substitute acid limes for the integrated production of citric acid, lime oil and pectin, at a cheaper rate.

25) Studies on preservation of palm fruit(Ad-hoc.81/5):

The project was taken up at the request of Khadi & Village Industries Board, Tamilnadu, as a part of industrial promotion in villages. Studies were conducted for processing of ripe palmyrah fruit and canning of tender kernles. Removal of the pulp from the fruit was found difficult and the yield was very low (14%). The pulp from the fruit was bright yellow in colour with characteristic strong aroma and was rich in sugars(22°Brix and 14.8% sugars) and βcarotene (110mg/100 mg). Squash, nectar, jam and fruit slab prepared from the pulp were quite good and acceptable. Tender palm-kernels canned in sugar syrup (40°Brix) were highly acceptable. Methods for the extraction of pulp and canning of tender kernels were standardised.

26) Trials on mango pulp/juice canning, eliminating the retorting step. (All India Project of H.Q.

It is a commercial practice to process the sealed tins of mango pulp or juice in boiling water for 20-30mts. This is the step in the process where considerable amount

of time and fuel are wasted. Lab trials indicated that this processing step is not at all required for the preservation of the canned juice. Hence commercial samples were drawn from different factories in the State with and without processing and their keeping qualities studied over a period of 1 year at RT. It was observed that there was no spoilage in any cans taken without retorting process and in fact these samples scored higher organoleptic rating than the processed pulp kept as control. The trials were conducted in two seasons and results confirmed. The results clearly indicate that retorting process can be completely eliminated in commercial canning, thereby saving enormous fuel energy and also increase the production capacity.

27) Survey on post-harvest problems of vegetables grown in A.P. with respect to their production, handling, transportation and keeping quality in different seasons.(ES-80/735):

A survey on the post-harvest problems of vegetables, right from the stage of harvesting to the retail marketing was conducted. Information on methods of harvesting, transportation, marketing practices, market arrivals of each commodity to different mandis were collected and compiled. Experiments conducted in the lab with different packing materials on the keeping quality of different vegetables indicated that the cheapest and best way of storing the vegetables at RT in fresh, condition is packing them in P.E. bags (300 guage) with few pin holes. By this the vegetables remained in fresh condition 3-6 days more than in the controls. The keeping qualities of some common vegetables packed by this method and control are; Brinjal 4 and 1, okra 7 and 3, french beans 10 and 4, green chillies 8 and 2, curry leave 7 and 1 respectively.

28) Study of rice production and processing systems in Punjab, Haryana, Vidarbha and Andhra Pradesh - its problems and solutions (RPT-46/704):

A survey was undertaken to study the problems of rice production, processing, storage and marketing systems prevailing in A.P. Paddy samples of 42 commercial varieties were procured from different places at different stages i.e., harvesting, threshing, storing and milling, and were analysed for their physico-chemical composition, milling and cooking characteristics. Data on the variation in the yields of different products such as head rice, husk, bran and brokens were collected. Information on the production of rice, districtwise, market arrivals, marketing systems etc. were collected. The moisture content at the time of harvest, threshing and milling varied widely from 12.0-20.3% and hence the paddy is sundried for one day in the mill before milling, wherever necessary.

29) Studies on production pattern and processing methodologies of common pulses in Punjab, and Haryana, U.P. M.P., Vidarbha and A.P. to identify main difficulties and initiate suitablegremedial measures (RPT-706):

A survey on production pattern and processing of pulses in A.P. was conducted. Information on production of different varieties of pulses produced region-wise, different processing practices employed, both at home and commerical level, the status of the existing dal mills in the State etc. were collected and data compiled.

30) Investigation on the direct utilisation of molasses for production of caramel liquid sweetners and free flowing granules (P.D. -778)

Molasses hitherto are used for the production of alcohol only in India. But a new commercial product, molasses granules was developed now in foreign countries, which have wide usage in food products for full or partial replacement of cane sugar in cake and bread mixes, soups and sauces, extruded foods, confectionery, beverages etc. Hence investigation was undertaken to develop suitable process for the preparation of molasses granules. Commercial samples of molasses from Khandasari mills and sugar refineries were collected and analysed to find out the variations in the quality. The molasses are partly refined to reduce the slight astringent taste, unpleasant flavour and the ash content by ion-exchange treatment and thereby making molasses more edible and platable. The methods of dehydration of molasses for converting them into free flowing granules are being studied.

III. SURVEYS:

The following surveys were conducted to assess the status and the problems of the industries in the State.

Sl.No.	Subject	Year
1.	Availability and marketing of mangoes in Krishna District, A.P.	1967
2.	Post-harvest problems of grapes grown in Hyderabad-Secunderabad.	1972
3.	Aflatoxin content in groundnut oil in A.P.	1974
4.	Study of present status of cashewnut processing industry in A.P.	1977
5.	Survey on post-harvest problems of vegetables grown in A.P.	1982
6.	Study on rice production and processing systems in A.P.	1982
7.	Study on production pattern and processing methodologies of common pulses in A.P.	1982
8.	Techno-economic survey of Indian Traditional Foods	1985
9.	Survey on economic data on agro-based food raw materials and processed foods.	1984

IV. TECHNICAL ASSISTANCE; The following technical enquiries were received and necessary advice given, as a part of promotional activity.

Year	Fruit & Veg. Processing	Grape dehydr-- ation	Cashew apple proce- ssing	Modern rice & Pulse and ragi procng.	Starch & tuber Procng.	Proteins & pro- tein foods	Papain manufa- cuting	Spices flavrs. and colors	Misc- lan- eous	Total
1965	7								1	8
1966	4	1								5
1967	4			1		1	1		1	8
1968	6	1		3		1			3	14
1969	13	4							6	23
1970	20	1							1	22
1971	3			1			1	2	3	10
1972	5					1			3	9
1973	9						1	2	2	14
1974	8	1	1		1			1	3	15
1975	14		2	21	9	3		9	9	67
1976	19			11	2	6			10	48
1977	4	2		2	2		7	2	9	28
1978	8			12		2	20	2	4	48
1979	13	2	2	3			8	2	8	38
1980	16	3		12			12	1	6	50
1981	15	4	2	7			4	2	8	42
1982	16		4	2			5	1	5	33
1983	12	6	3	20			4	2	12	59
1984	22	2	2	10				2	7	45

V. Supply of Schemes, products, blue prints etc:

The following schemes and products were supplied to the prospective enterpreneurs as a part of promotional activity.

Scheme/Product	Supplied to	Year
1. Pectic enzyme	M/s. Kamal Nehru Girl's Polytechnic, Hyderabad	1967
2. Fruit bars	M/s Foods & Fruits Visakhapatnam	1967
3, Fish oil sample	Dept. of Technology Osmania Univ. Hyd.	1968
4. Mini Fume Tablets	M/s F.F.F.Ltd., Tadepalligudem	1968
5. Through flow drier, blue print	M/s Srinivasa Industries Hyd.	1971
6. Scheme for dehydration of grapes	Grape Growers' Society, Hyd.	1972
7. Protein chewy candies	M/s Nutrine Confectionery Pvt. Ltd., Chittoor	1972
8. Honey Processing & Fruit Processing plants	M/s. Girijan Coop. Corpn.Ltd., Visaptnm.	1975
9. Potentials for setting up fruit processing industries in A.P.	A.P. State Coop. Marketing Federation, Hyderabad	1975
10. Scheme for Food Testing lab.	A.P. State Federation of Consumers' Central Coop. Stores Ltd., Hyderabad.	1976
11. Scheme for 14 food industries	Directorate of Industries A.P. Hyd.	1977
12. Scheme for 10 food industries	CSIR Polytechnological clinic, Hyd	1977

1	2	3	4
13.	Scheme for production of annatto dyes	Karnataka State Forest Industries Corpn.Ltd., Bangalore	1978
14.	Food Industries for A.P.	A.P.State Agro Industries Corpn.Hyd.	1979
15.	Raisin Production	M/s Liladhar Naranji & Sons Thimmapur	1979
16.	Modern par-boiling units	Dept. of Industries, A.P. Hyd.	1979
17.	Potentials for establishing food industries in Chittoor Dist.	Dpt. of Industries, Govt. of A.P. Hyd.	1980
18.	Scheme for processing cashew apples	-do-	"
19.	Scheme for processing fruits & Vegetables.	Girijan Coop.Corpn. Ltd., Visakhapatnam	"
20.	Tuti-fruity preparation	M/s. Sapid fruit canning Industries, India, Edara	1981
21.	CNS Liquid (2.0 lt. supplied)	M/s. Bakelite Hylam Ltd., Hyderabad	"
22.	Annatto colour supplied (100g)	Lipid Technology, CFTRI, Mysore	"
23.	-do-(500g)	M/s. Sun Sip Ltd., Hyd.	"
24.	-do- (50g)	CFTRI E/S. Nagpur	"
25.	Papain Production	M/s. Papain & Chemicals Pvt. Ltd., Cochin	"
26.	Assay of Bixin	M/s. Boggavarapu Bros, Kakinada	"
27.	Dhal Mill	M/s SAK Industries Hyderabad	"

1	2	3	4
28.	Rice Bran Stabilisers & Oil	A.P.S. Civil supplies Corpn.Hyd.	1981
29	Raisin Production	Sri. B.H.Joshi, Hyd.	1981
30.	Assay of Papain	Mr. Dinesh S.Oza	1982
31.	Chilli Varieties suitable for oleoresin.	M/s. Herbochem, Hydera-bad.	1982
32.	CNS Liqqid, modern dhal mills and papain	A.P. Indl. & Technical Consultancy Organisation, Ltd. Hyd.	1982
33-	Modern Dhal Mill	M/s Gopikrishna Dal & Oil Mill, Narasaraopet	1983
34.	-do-	M/s Kanyakaparameswari dal mill, Vinukonda	1983
35.	-do-	M/s Kalyani Food Products, Khammam	1983
36.	Baking powder manufacture	M/s Bajaj Foods Hyd.	1983
37.	Custard powder		
38.	Tuty-fruity	M/s. K.Srinivasa Hyd.	1983
39.	Pre-investment report on production of raisins.	M/s. Jusip Food Products, Isnapur	1983
40.	Pre-investment report on production of raisins.	Mr.Syed Iqbal,Hyd	1983
41.	Setting up a quality control lab.	M/s. Banjara Foods & Spices Ind.Hyd.	1983
42.	Production of tuti-fruity	Mr.K.Srinivasa, Hyd.	1983
43.	Post-harvest preservation and Prosg. mangoes	Asst.Director of Hort.Govt.of A.P.Hyd.	1983
44.	Scheme for processing of mangoes	Smt. Hemalatha Reddy, Avadi	1984
45.	Raisins from grapes	M/s.Malligi Foods & Chemicals Hospet	1984
46.	Fenny production	Sri. V.Venkateswara Rao	1984
47.	Starch and Glocose-tapicca	APACE, Govt. of A.P.Hyd.	

VI. CONSULTANCY AND SPONSORED PROJECTS:

The following consultancy programmes and sponsored projects were undertaken under technical guidance to the industry.

Subject	Name of the party	Year
1. Food based Agro-Industries	A.P. State Agro-Industries Corpn. Ltd., Hyd.	1980
2. Export of Canned mango products - standard quality maintenance.	State Trading Corpn. of India Ltd., New Delhi	1980
3. Food based Agro-Industries	A.P. State Agro-Industries Corpn. Ltd., HYD.	1981
4. Production of Refined Papain (Sponsored Project)	Sri. Thomas Jone, Thodupuzha	1981
5. Export of canned fruit products and quality maintenance.	State Trading Corpn. of India Ltd., N.Delhi	1982
6. Export of canned fruit products and quality maintenance	-do-	1984

VII. PROCESSES RELEASED TO INDUSTRY:

The following processes were released to Industry:

Processess	Address of the party	year
1. Ready mixes	M/s.Foods, Fats & Fertilisers Ltd., Tadepalligudem.	1968
2. Manufacture of fruit bars	M/s Foods & Fruits, Visakhapatnam	"
3. Egg coating oil 4. Egg Washing powder 5. Egg washing machine	M/s. Hardcase Engg. Works, Secunderabad	"
6. Distillation of Cardamom oil.	M/s.P.M.Desai, Hyderabad	1969
7. Egg Albumin Flakes	M/s. A.P.S.S.I.D.C. Hyderabad	1971
8. Tamarind juice Cons.	M/s Mahalakshmi Inds. madanapalli	"
9. -do-	M/s. Vincon Food Processing Co., Mangalagiri	"
10. Spice oleoresins	M/s.Biological Evans, Hyd	"
11. -do-	M/s. A.P.S.S.I.D.C.,Hyd.	"
12. Garlic Powder	-do-	"
13. Fruit Bars.	M/s. Kesari Fruit Products, Visakapatnam	1972
14. -do-	M/s. A.P.S.S.I.D.C., Hyderabad.	"
15. -do-	M/s Tropical fruits, Chittoor	"
16. Papain manufacture	11 parties	1978
17. Grape dehydration	M/s. Ranchi Enterprises & Properties Ltd., Hyd.	1978
18. Refined papain	Sri. Thomas Jose, Thodupuzha	1982
19. Grape dehydration	Sri. S.S.Chawla, Hyd.	1982

20. Grape dehydration	M/s J.J.Farm, Hyd	1982
21. -do-	M/s Garison steel Alloys, Hyd.	1982
22. Grape dehydration	M/s. Jusip Food Products, Isnapur	1983
23. -do-	M/s. Gopikrishna Dhal & Oil, Mill, Narasaraopet.	1983
24. Modern Dhal Mill	M/s Gopikrishna Dhal & Oil, Mill,	
25. -do-	M/s. Kanyakaparameswari Dhal Mill, Vinukonda.	1983
26, -do-	M/s. Kalyani Food Products, Khammam.	1983
27.Papain manufacture	6 parties.	1984.

VIII. LECTURES & DEMONSTRATIONS:

The following technical lectures and processes demonstra tions were given to the prospective enterpreneurs as a part of promotional activities.

Institution.	Location	Subject	Year
1. Grape Growers' Society, Hyd.	Hyderabad	dehydration of Anab-e-shahi grapes	1972
2. Market centres of karimnagar Dt.	Malkanur Jammikunta Peddapalli Karimnagar Metapalli Jagtial Koratla	Pest Proofing gunny ba gs, bulk fumigation of food grains.	1974
3. All India Radio TV Base, Hyd.	Hyd.	Products from sitaphal	"

4. College of Veterney Science, A.P.A.U., Hyderabad	Hyderabad	Canning of Chicken	1974
5. Rice millers Association	Karimnagar	Rubber roller sheller demonstration	1974
6. Dept. of Industries, Govt. of A.P.	Nellur	Intensive campaign for indl. developmnt	1974
7. M/s. Girijan Coop. Corpn.Ltd., Visakhapatnam	Hyderabad	Honey clarification	1975
8. M/s Arun Grape Gardens	-do-	Inpackage fumigant for grape transportation	"
9. M/s.Kimtee Grape Gardens	-do-	Sun drying of grapes	"
10.Dept. of Industries, Govt. of A.P.	-do-	Intesive campaign for indl. devemnt.	"
11. College of Home Science	-do-	Canning demonstration	1976
12. A.P. Grape Growers' Association	-do-	Dehydration of grapes	"
13. Osmania University	-do-	Lectures on Food Processing and preservation.	"
14. Central Warehousing Corporation	-do-	Lecture on food preservation	"
16. Kamal Nehru Polytechnic for Women	-do-	Fruits & Veg.Industry	"

17. A.PAU, Summer Institute	Myderabad	Raisins Production	1977
18. Rural Worker's Education Camp, Sponsored by Ministry of labour, Govt of India.	Hayatnagar	Preservation of food stuffs	1979
19. -do-	Shadnagar	-do-	"
20. -do-	Jangoan	-do-	"
21. Trainees of food Inspectors Food & Drug Control Dept Govt. of A.P.	Hyderabad	Quality control of fruit Products	"
22. Mr. Rames Parekh, Jt. Secretary A.P. Grape Growers' Asson.	-do-	Dehydration of Grapes	"
23. Mr.L.R. Goeal, Ludh.	-do-	-do-	"
24. Mr.B.M.Acharya, Hyd.	-do-	-do-	"
25. Wg.Cdr. Swamy, Visakahapatnam	-do-	-do-	"
26. SIET Institute Trainees for promotion of Agro-Industyris	-do-	Promotion of agro-industries.	1980
27. Agricultural Res.S ub-Stn.	Malyal	Improved technique for chilli drying demonstration	"
28. S.I.S.I.	Hyderabad	Preparation of jams, jellies & squashes	"
29. SIET Institute Trainees for Techno Managerial Programme	-dO-	Rice & Maize processing.	1981
30. -do-	-do-	Fruit & Veg. preservation and canning	1981.

31. Rajashtani Graduates' Association.	Hyderabad	Role of agro-industries in rural development	1981
32. Kamala Nehru Polytechnic for Women	"	Food colours	1981
33. Sri. Ramesh Parekh	"	Grape dehydration (Demonstrn)	1981
34. College of Home Science Students 35. Food Crafts Institute 36. Community Canning & preservation centre, staff.	"	Preparation of custard apple products	1981
37. Sri. Thomas Jose, Thodupazha	Mysore	Refined papain demonstrn.	1981
38. Sri. S.S.Chawla, Hyderabad	Hyderabad	Grape dehydration demonstration	1982
39. M/s J.J.Farm, Hyd.	-do-	-do-	"
40. M/s. Jusip Food products Isnapur.	-do-	-do-	1983
41. Mr. Syed Iqbal, HYDERABAD	-do.-	-do-	1983
42. Dhal Millers Asson. Narasaraopet.	Narasaraopet	Modern dhal milling	1984
43. A.I.R. Broadcast, Hyderabad	Hyderabad	Preservation of Foods	1984
44. M/s Malligi Foods and chemicals, Hospet	-do-	Grape dehydration	1984
45. Workshop on Modernisation of rice mills, organised by civil supplies Dept. Govt. of Andhra Pradesh	Anantapur	Modernisation of Rice mills	1984

46. Workshop on Modernisation of rice mills, organised by Civil Supplies Dept. Govt of A.P.	Chittoor	Modernisation of Rice Mills	1984
47. -do-	Nellore	-do-	1984
48. -do-	Tadepalligudem	-do-	1984
49. Entrepreneurs-6	Mysore	Papain manufacture	1984
50. APACE Departmental Officers Trainees	Hyderabad	CFTRI Processes	1984

IX. ANALYSIS AND TESTING OF INDUSTRIAL SAMPLES:

The following industrial samples were tested and suitable advice given to improve the quality of the products.

Analysis/test	Requesting party	year
1. Microbilogical Evaluation of Egg powder	M/s. Biological Evans, Hyderabad	1968
2. Analysis of rice (2 samples)	The Vijnan Mandir Officer, Rajahmundry	"
3. Black gram culture	Asst.Millet specialist, Millet Research Stn. Peddapuram	"
4. Fruit Bars	M/s. Foods & Fruits, Visakhapatnam	"
5. Cooking and other quality characteristics of improved rice strains(20)	All India Co-ordinated Rice Improvement Project, Hyderabad.	1969
6. Rice bran samples	N.I.N.Hyderabad	"
7. Chilli samples	Chillies Res. Officer, Guntur	"

8. Toffee Bar	M/s.Nizam Sugar Factory, Hyd.	1969
9. Food colours	M/s. K.C.P.Ltd., Vyyyur	1970
10.Chilli Oleoresin	M/s Boggavarapu Bros. Kakinada	"
11. Mango pulp	State Bank of India, Vijayawada	1971
12.Tamarin Juice concentrate	M/s Venkateswara Food processing pvt. Ltd., Nidadavole	"
13. Wafer Biscuits	M/s International Foods, Hyd.	1974
14. Honey	M/s Girijan Coop. Corpn. Visakhapatnam	"
15. Fruit squash & jam	-ddo-	"
16. Tin content in canned mango juice	M/s Sun Sip Pvt. Ltd., Hyderabad	1975
17. Calcium content in canned potato	-do-	"
18. Dehydrated onions	M/s Circar Dehydrates Ltd., Kakinada	1975
19. Red chillies powder	M/s Moghul Foods, Hyderabad	"
20. Wappers for packing biscuits.	M/s Interfood Pvt. Ltd., Hyderabad	"
21. Waffer Biscuits	M/s Interfood Pvt. Ltd., Hyderabad	1976
22. Tamarind pulp (8 samples)	M/s SIET Institute, Hyderabad	"
23. Tamarind concentrate	M/s Girijan Coop. Hyderabad	"
24. Honey (samples)	Apiary Development Officer, Girijan Coop.Corpn. Narasipatnam	1977
25. Fried Noodles (3 samples)	CARE, A.P. Hyderabad	1977
26. Winery Waste (4 samples)	M/s Myltar Corpn. Hyderabad	"

27. Indian Sweet	Dr.A.S.Raju, Hyderabad	1977
28. Biscuits	CARE, Hyderabad	1978
29. Groundnut cake	M/s Sri.Ganesh Oil mills Hyderabad	"
30. Honey (5 samples)	M/s Girijan Coop. Corpn.	"
31. Tamarind concentrate	APSSIDC, Hyd.	"
32. -do-	-do-	1979
33. Honey	Girijan Coop. Ltd., Narasipatnam	"
34. Chilli Oleoresin	M/s Saran Chemicals, Hyd.	"
35. Soya Salad Oil (4 samples)	CARE A.P. Hyd.	"
36. Bees wax	Girijan Coop.Corpn. Ltd., Narasipatnam	1980
37. Biscuits	Biscuit factories(9) Hyd and ISI, Hyd.	1981
38. Maida	Biscuits factories(3), and ISI, Hyd.	"
39. Macaroni	M/s Shakti Products, Hyderabad	"
40. Instant Coffee-chicory powder	M/s Brooke Bond India Ltd Hyd and ISI Hyd.	"
41. Vanilla Powder	M/s Vanillin & Fine chemicals Ltd.,Hyd	"
42. Biscuits	Biscuit factories(3), Hyd. & ISI, Hyd.	1982
43. Maida	Biscuit factories (4), Hyd.ISI, Hyd.	"
44. Soya Salad oil 45. Corn soya Meal 46. Defatted soya flour 47. Muruku (snacks)	CARE A.P. Hyd.	1982
48. Maize 49. Niger seed	A.P.Civil supplies Corpn.Hyd	"
50. Edible groundnut flour	RTE Processed food factory,Hyd.	"

51.	Tomato cauce	M/s. Safal Food Products, Hyderabad	1983
52.	Biscuits (17 samples)	Biscuit Factories(6)Hyd.	1983
53.	Custard powder (2 nos)	M/s. Bajaj Foods, Hyd.	"
54.	Coffee-chicory powder (3)	M/s Ramakrishna Coffee works, Tadipatri	1983
55.	Maida (2)	Biscuit Factories(2) Hyderabad	"
56.	Curry & Coriander powder(2)	M/s. Banjara Foods & spices Ind. Hyd.	"
57,	Baking powder & vanilla Powder (2)	M/s. Bajaj Foods, Hyd	"
58.	Groundnut flour	M/s Sehar Goods P.Ltd Miryalguda	"
59.	Tomato sauce	M/s Sapid Food Products, Hyderabad	"
60.	Papaya glazed fruit	M/s Indian Tropical enzymes, Hyd.	"
61.	Energy Food	M/s A.P.Protein Foods, & sales Pvt. Ltd.,	"
62.	Baking powder		
63.	Aluminium sulpahate	M/s. Bajaj Foods, Hyd	1984
64.	Tomato paste	M/s Venkateswara Fruit Processing Ltd., Nidadavole	"
65.	Sod. Benzoate		
66.	Food Sauce	M/s Gross society, Hyd	"
67.	Apple jelly	M/s. J.Food Products Hyderabad.	".

X. Researdh Papers Published.

The following technical papers were published, based on the researchprogrammes of the centre.

1. Evaluation of some musk melon varieties of A.P. for canning a nd preparation of nectars, Suryaprakasa Rao P.V. Prasad P.S.R.K. and Negeswara Rao G., Indian Food Packer, 1968, 22(3),11.

2. Evaluation of mango varieties of A.P. for processing as slices, nectars and juices. Suryaprakasa Rao, P.V., Prasad P.S.R.K., Negeswara Rao and Giridhar, N. INDIAN Food. Packer, 1968,22(5),15

3. Cmminuted citrus beverage. Suryaprakasa Rao, P.V., Prasad P.S.R.K., Negeswara Rao G., and Giridhar N, Indian Fd. Pakker 1968, 22(5),15.

4. Canning of sweet orange I-preparation of segments for canning. Suryaprakasa Rao P.V., Giridhar N, Prasad P.S .R.K., and Negeswara Rao G., Indian Fd. Pakcer 1969, 23(1)26.

5. Canning of sweet orange II. Canning of segements and circles. Suryaparakasa Rao, P.V., Giridhar N, Prasad P.S .R.K., and Nageswara Rao G., Indian Food. Packer, 1969,23(2),42

6. Canning of sweet orange III - observations on the influence of certain factors affecting segment integrity. Suryaprakasa Rao, P.V., Giridhar N, Prasad P.S.R.K., and Nageswara Rao G., Indian Fd.Packer, 1969 23(3),5.

7. Optimum maturity and harvesting time of mangoes var.Baneshan:
I-Physico-chemical features of fruit vs.maturity. Suryaprakasa Rao P.V., Giridhar N., Prasad P.S.R. K. and Nageswara Rao, G., Indian J.Hort, 1970, 24(3-4),117

8. Optimum maturity and harvesting time of mangoes Var. Baneshan Part-II Physico-chemical components of fruit vs. maturity. Suryaprakasa Rao P.V., Giridhar, N., Prasad P.S.R.K., Nageswa ra Rao G., Indian J.Horti. 1972,(29(2),126

9. Utilisation of mango waste: peel as a source of pectin Beerh, O.P., Raghuramaiah B and Krishna Murthy G.V., J.Fd.Sci. Techn., 1976(13)(2), 96

10. Effect of pre and post-harvest treatments to control some common disorders in Anab-e-shai grapes. Beerh O.P., Krishna Murthy, G.V., Narasimham P., Giridhar N. and Raghuramaiah B., Jr.Fd.S ci.Techn., 1976,13(3)129.

11. Utilisation of mango waste: Recovery of juice from waste pulp & peel, Beerh O.P., Raghuramaiah B., Krishna murthy G.V. and Giridhar N., Jr.Fd.Sci.Techn.1976, 13(3),138.

12. Studies on aflatoxin content of grounnut oil in A.P. with reference to climatic conditions and seasonal variations. Giridhar N., and Krishna Murthy, G.V., J.Fd.Sci. Techn. 1977,14,84

13. Custa rd apple (Annona squamosa) Part-I Physico- micro morphological characters and chemical composition, Beerh O.P., Giridhar N., Raghuramaiah B., Indian Fd.Packer, 1981, 35(1),

14. Papaya - a commercial crop for the production of papain and pectin. Krishnamurthy G.V., and Natarajan C.P., Cultivation and utilisation of Medicinal plants R.R.L. Jammu Tawi, 1982, pp 436-445.

15. Suitability of some mango varieties for processing. Krishnamurthy, G.V., Giridhar N. and RaghuramaiahB., Jr.Fd.Sci.Techn. 1984,21,21.

16. Studies on transportation of Anab-e-shahi grapes. Krishnamurthy G.V., Beerh O.P., Giridhar N., and Raghuramaiah B.,

Jr.Fd.Sci.Techn., 1984,21 132.

XI. Papers presented at Symposia, Conferences and Seminars:

The following technical papers were presented in the Symposia and seminars.

1. Indian Convention of Food Scientists & Technologists, held at Mysore, in June, 1978:

   a) Preparation of annatto dyes from Bixa-Orellanna seeds (Krishnamurthy, G.V. and Giridhar N.)
   b) Preparation and application of sucrose esters (Venkateswara Rao M and Giridhar N.)
   C) Studies on preparation of fruit slabs from papaya (Krishna murthy G.V. and Verma V.K.)
   d) Transesterification of sardine fish oil and veg oil blends for canning of fish (Venkateswara Rao M, Gadem P.H. and Sivasamban M.A.)

2. All India Coordinated Fruit Improvement Project - Mango workers meeting, held at Panji, Goa, from 2nd -5th May 1979

   i) Screeing of some important varieties of mangoes grown in A.P. for their suitability for canning and juice making (Krishnamurthy G.V. and Giridhar N.)

3. All India Food Preservers Association Annual Meeting, held at Bangalore on 11th and 12th August, 1979.

   i) Utilisation of mango processing waste - an integrated approach (Krishnamurthy G.V.)

4. By-products from food industries: Utilisation and disposal, held at Mysore on 29th and 30th May, 1980.

   i) New products from fruit & veg. processing wastes (Krishnamurthy G.V.)

5. National Work-shop on post harvest management of grapes, held at Pune, from 4th - 6th February, 1985.

   i) Transportation quality of Indian Grapes (Krishnamurthy, G.V. Giridhar N., and O.P.Beerh)
   ii) Grape dehydration for the production of raisins (Krishna M urthy G.V.).

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III ~~IV~~. EXPERIMENT STATION LUCKNOW

WORK DONE AT CFTRI EXPERIMENT STATION, LUCKNOW SINCE 1963

Central Food Technological research Insitute Experiment Station at Lucknow was established in 1963 to fulfil a long felt need for a centre which could take up problems of regional food industry and carry out R&D work to enable the food industry in Northern India to utilize the fruit and vegetable resources of the region to full extent. The Experiment Station, originally situated in a rented building, was shifted to the Pilot Plant Building of CDRI. The main objectives of the Experiment Station are:

(A) To conduct varietal trials of Fruits and Vegetables grown in the region with a view to screen out varieties suitable for canning in Co-operation with the local Horticultural Research Stations.

(B) To conduct investigations on the problems of the industry and to develop new products.

(C) To establish closer technical liaison between industry and research and also offer advice in planning and setting up of new factories.

(D) To serve as an extension centre of CFTRI, Mysore.

The R&D work carried out at the Experiment Station can be grouped under four broad heads:

(I) Better utilization of raw materials: Improvement in quality of canned as well as dehydrated fruits and vegetables.

(II) Wastage minimization

(III) New product/process development

(IV) Liaison and extension activities.

(I) Better utilization of raw materials: Improvement in quality of canned as well as dehydrated fruits and vegetables.

Varietal characteristics and degree of maturity of fruits and vegetables are of crucial importance in determining the quality of the canned and dehydrated products. Hence one of the valuable lines of work at this Experiment Station has been screening of varieties as well as finding optimum maturity levels for canning and dehydration of different fruits and vegetables of the region.

1) Apricot

Many varieties of Apricot, cultivated over an area of 1600 hecters, is an important fruit crop of Kumaon region of Uttar Pradesh.

Fruits of ten varieties of Apricot were obtained from Government Research Station, Chaubatia (Distt. Almora) and physical characteristics, sensory qualities and chemical composition of fresh fruits were studied before canning. It was seen that all the varieties except Charmaghz had chemical constituents falling within a narrow range and in all the varieties the ascorbic acid content was moderate. In an overall assessment the varieties Turkey and Moorpark were the best and the variety St.Ambroise moderately good.

On canning trials, (to assess suitability of different varieties for canning prepared halves were packed in 1 lb. butter cans, covered with syrup and processed) it was found that, the variety Turkey gave a product excellent in all respects followed by St.Ambroise, Charmaghs, and Frogmore Early. The varieties Seedling, Moorpark and Royal

did not give products of acceptable quality either due to disintegration of the pieces or due to fibrous texture. The optimum stage of maturity for canning was found to be middle maturity stage, i.e. 'eating ripe' stage.

2) Cabbage

Canned cabbage, largely consumed by defence forces, suffers from pink discolouration on storage. Canning trials with ten varieties of cabbage, obtained from Government vegetable farm, Kalianpur, Kanpur were carried out. When canned according to standard procedure all the ten varieties exhibited pink discolouration on storage. Blanching with Potassiummetabi-sulphite before canning, however, was found to prevent pink discolouration.

The varieties Golden Acre, drumhead, and Lucknow Local were good for canning. However, as chunks, Pride of India and Infusion of Glory, although only moderate canning varieties, can also be used.

3) Cauliflower

Canned cauliflower is also mostly consumed by defence forces. The problems frequently encountered by processors are pink discolouration, softening and disintegration of the product on storage.

Six important varieties of caluliflower obtained from Government vegetable farm, Kalianpur, Kanpur were taken up for canning trials.

All the six varieties, when canned by usual method gave soft products which also showed pink discolouration after 3 to 6 months storage.

The following treatments were found to prevent pink discolouration and gave a product of firm texture:

Blanching the material at 185°F for 15 minutes in 2% Calcium Chloride solution containing 350 ppm. sulphur-di-oxide, soaking the blanched material in 5% calcium chloride solution for one hour, washing, and canning in the usual way. Three of the six varieties, Snowball, Lucknow Local and Anjha were found most suitable for canning.

4) Peas.

The State of Uttar Pradesh with 33,665 hectares under pea accounts for more than half of the total area under this crop in the country. Eighteen important varieties of pea grown in Northern India were studied for their bearing characteristics, physical characteristics of pods and seeds, physical and organoleptic quality of seeds, and varietal suitability for canning.

The varieties Marrowfat, Blue Bantham, and Pride of India were found to be good yielders whereas Wando, Benarsi Sweet, and T-19 were medium yielders. Evaluation for pod and seed size, colour, shape and taste showed Blue Bantham and Marrow fat to be the best of varieties. Pride of India, Banarsi Sweet, Wando and Dalwitch Kamando came next in order of preference. There was no appreciable difference among the varieties in their chemical composition.

Of the 18 varieties studied only 4 were found to be suitable for canning. These were: Type-19, Dalwitch Kamando Wando, and Benarsi Sweet. All of these retained good colour after processing, showed low percentage splitting and did not develop turbidity in the covering brine and also performed vary well in the organoleptic evaluation.

Optimum stage of maturity for canning for Indian culinary preparations:

The peas with sp.gr.1.071-1.086 having alcohol insoluble solid content around 25% gave a canned product most suitable for Indian culinary preparations.

5) Litchi

Many important commercial varieties of litchi fruit are grown in North Bihar and Uttar Pradesh, the total production being about 90,000 tonnes. Commercial canning of litchi is done on a small scale in Bihar and U.P. Dehydration of Litchi is not commercially done at present in India. A detailed study to screen the most suitable commercial varieties for canning and dehydration was undertaken.

a) Varietal canning trials: Seven varieties of Litchi were directly procured from the orchards of Saharanpur, Dehradun, Pantnagar, Ramnagar and Muzaffarpur(Bihar) indicated that the varieties Early Large Red from Saharanpur, Early Seedless from Dehradun and Saharnpur, Rose Scented from Dehradun and Pantnagar and Sahi and China from Mizaffarpur were the most suitable for canning.

b) Preservation of Pink discolouration in canned Litchi:

Slight to heavy pink discolouration in canned litchies of all varieties can be attributed to the presence of colourless Leucoanthocyanins in fresh litichies which gets converted to pink anthocyanidins on heating in acid media.

Method to prevent pink discoloration has been standardised. Canning Litchies in 30^{o}Brix syrup containing 0.10%-0.15% added citric acid depending on the initial acidity of the fruit, so that final pH of canned

Litchi is around 4.5, processing for not more than 10 minutes in boiling water (for No.1 tall or 1 lb. butter cans), immediately cooling thereafter, preferably under chilled water was adequate to prevent pink discoloration.

c) Dehydration of Litichies:

Dehydration studies of litchies both as whole and pecled were conducted. Whole dehydrated Litchies were more appealing, showing original look of fresh fruits.

Drying conditions were standardised. Litchies after blanching and sulphuring dehydrated at a temperature of 70°C to a moisture level of around 20% gave a good product.

Out of five varieties tried for dehydration studies, varieties Kalkatia, Sahi China gave a good product.

6. Guava

Uttar Pradesh has an area of 70,000 hectares under Guava and safeda is the most important variety.

a) physico-chemical changes during development of safeda Guava fruit:

Changes in physical and chemical properties of Safeda Guavas accompanying fruit maturation on the tree were investigated from fruit set to full ripe stage. Composite samples were examined at 10 day interval during initial growth and at 5 day intervals during repening. The study included fruit height and diameter, weight and volume, specific gravity, percentage edible portion, colour development, total and reducing sugars, acidity, total soluble solids, ascorbic acid, total pectin and tanins, starch, alcohol insoluble solids and ash.

The Guava fruit took 140 days from fruit set to fruit drop. It shows near optimum quality for eating about 125 days after fruit set, when after there is not much change in fruit growth,, accumulation of sugars, ascorbic acid and acidity of the fruit, the fruit is soft and yielding to pressure and the colour is uniform yellow In the days following yellowing of the fruit, the soluble solids and sugar contents decline, the ascorbic acid rapidly decreases and the moisture content of the fruits starts increasing. These are changes one might associate with the onset of senescence.

b) Effect of maturity of Safeda Guavas on flavour preference:

This study was undertaken with a view to provide some well identified parameters for harvesting of guavas for processing purposes. Fruits of five distinct maturity stages designated as 'mature','quarter ripe', half ripe, eating ripe and full ripe, which broadly corresponded to 90 days, 100 days, 110 days, 130 days and 135 days respectively, were harvested and subjected to canning trials. The canned products were evaluated for colour, general appearence, aroma, texture and flavour..

The stage of maturity most suitable for canning was seen to be 'full-ripe' stage.

c. Development of a method to prevent pink discolouration of slices and milkiness in the covering syrup:

Canned Guavas on storage were seen to develop pink discolouration and milkiness in the covering syrup. The presence of leuco-anthocyanins in the fruit was ascertained.

Variation of processing conditions, use of fruits of different maturities and use of different additives were tried. Steeping the fruit in 0.5% Potassium metabisulphite solution for 2 hours before canning so that at least 80 p.p.m. Sulphurdi-oxide remained in the canned product, prevented the development of colour altogether. aHowever, addition of preservatives in canned fruits is not permissible. No other treatments gave an uniformly satisfactory product.

7) Mango

Development of a method for retaining maximum flavour in canned Dasheri:

Dasheri is the most important table variety grown in Uttar Pradesh. It is widely used by the processing industry.

When canned as slices in syrup, fla-vour of the product is not very well retained though the fruit colour and texture remain very good. With a view to overcome this drawback, various factors viz, rawmaterial quality stage of ripeness, processing conditions, and chemical additives, that are likely to influence the flavour of canned product were studied.

It was seen that addition of only ascorbic acid at a rate of 100-200 mg. per 100 g. syrup helps in flavour retention.

(II) Wastage minimisa-tion:

Large quantities of fresh fruits get spoiled during handling, transportation, and storage. In order to minimise these losses it is essential that the relation between harvest maturity and keeping quality of fruits during storage and transpprtation be known.

1. Study of the ripening behaviour, optimum harvest maturity and storage of Dasheri, Langra and Chausa varieties of manges:

Uttar Pradesh grows 4 million tonnes or 53% of the total all India mango production. Spoilage during ripening and storage is reported to be around 20%.

This study was undertaken to find out the relationship between harvest maturity and keeping quality of the fruits during storage, so that wastage could be minimised.

Dasheri and Chausa, the most important grafted varieties grown in U.P. were taken for these studies.

Physico-chemical changes of the fruit (starting from the fruit set) during growth were studied.

Fruits were bulk harvested at 4 stages - 90,105, 115, and 122 days old in Dasheri, and 85,100,114 and 125 days old in Chausa variety. The harvested fruits were kept for ripening at room temperature. Physiological loss in weight, ripening pattern, softening and other physical changes were recorded at regular intervals during storage. Economic storage life was worked out on 10% loss. It was observed that storage life was longer in earlier harvests. The storage life increased inversely with the age of the fruit. The figures for the two varieties were as follows:

Variety of fruit	Stage of harvest (days)	Storage life(days)
Dasheri	90	11
	105	8
	115	7
	122	5

Variety of fruit	Stage of harvest (days)	Storage life(days)
Chausa	85	9
	100	7
	114	7
	123	6

2. Physiological changes in Potatoes during both cold and underground storage and effect of cold storage on canning:

Seven important commercial varieties of potatoes were procured from Central Potato Research Institute's Potato Production Station, Daurala. They were kept in a commercial cold storage. Physico-chemical analysis of all the varieties were done after harvest and at monthly intervals during period of 8 months cold storage.

Fresh potatoes of all the varieties immediately after harvest and cold stored potatoes after 3 and 6 months storage were canned in the usual manner. Cutout analyses of the canned product were carried out after 1,4 and 7 months storage at room temperature.

Potatoes of all the seven varieties, when canned immediately after harvest gave products which remained readily acceptable even after 7 months storage at room temperature. When canned after 3 and 6 months cold storage, all the varieties except Kufri Alankar, were of acceptable quality even after 4 months storage at room temperature.

III New products/Process Development

1. Standardisation of canning process for water Chestnut (Singhara)

Indian Water Chestnut (Singhara), grown in an area of 4000 hectares in U.P., is either eaten fresh or the fully matured nuts converted into flour after drying.

As there are possibilities of development of internal as well as export market for the canned product, a detailed investigation was undertaken on the canning of Water Chestnut, and the method standardised.

Mature nuts having 4-7% starch, separated by brine floatation method, first hand, peeled and then lyepeeled in 2% boiling sodium hydroxide solution for 1/2 to 2.0 mts. followed by trimming and dipping in Citric Acid solution. The nuts after washing were canned in brine containing 2.85% salt, 5% Sugar and 0.2% Citric Acid. Plain cans were used and processing was done at 113.6°C for 45 mts. (A 21/2 cans). The canned nuts had a crisp texture, and were of good taste and flavour, free from discolouration.

6. Indigenous sweets Partially or wholly based on Fruits and Vegetables.

Recipe and method of preparation for two Indian sweets viz. Carrot Halwa and Bottle gourd Burfi have been standardized. Processing conditions for preserving Carrot Halwa in cans have also been standardized after conducting processing trials involving pretreatment of ingredients like acidification, variation in processing time and temperature etc.

Tests for bacteriological quality after incubating at 37°C and 55°C have shown the product to be sound and safe. The cans stored at room temperature remained bacteriologically sound and organoleptically acceptable over a period of one year

Bottle gourd Burfi prepared according to standardized recipe, filled hot into cans and cooled immediately was seen to be highly acceptable over a period of one year.

3. Standardization of method for dehydration of Apricots:

Apricots grown in Kumaon region of U.P., if dried as such give a product dark in colour, acidic to taste, leathery in texture and hence unacceptable. To remedy these drawbacks a method, involting improvement of sugar-acid blend of the fruit, was developed.

Out of six varieties of apricots tested for their suitability for dehydration, Moorpark gave the best product followed by New Large Early. Apricots of eating ripe maturity stage were found best suited for dehydra tioh.

Washed, halved and destoned fruits were steeped in syrup containing 1.5% Potassium-Meta-bi-sulphite for 36 hours, drained, and dried in a crops flow dehydrator at 68-70°for 20 hours. The Apricots dehydrated as above, if packed in air tight containers, remained acceptable for nearly one year at room temperature.

4. Dehydration of Parwal

Dehydration trials using a crossflow dehydrator were conducted on one commercially important variety of Parwal namely Desi (Bhit), A method for making a dehydrated product of good acceptability was standardized.

5. Starch from Waterchestnut

A study to assess the suitability of Water Chestnut as an additional source of starch for industrial purposes was carried out.

For isolation of starch from dried Kernel, six different methods - three based on treatment with sulphite, two based on treatment with chlorine and one based on treatment with sodium hydroxide - were tried.

Starch in each case was isolated after gravity settlement. The recovery of starch was more than 80% by treatment with sulphite, less than 65% by chlorine treatment, and about 70% by sodium hydroxide treatment.

The study showed that waterchestnut could very well serve as an additional source of starch and the best method for isolation of starch from dried nuts was the sulphite treatment method.

6. Musk Melon:

Standardisation of the method of canning.

Musk melon softens considerably during processing. An acceptable canned product with good flavour was prepared by soaking the segments in 2% Calcium chloride solution before canning.

Canning of sweetened pulp with addition of ascorbic acid during mincing gave a very good product.

7. Sponsered Projects:

Improving the shelf life of Litchi Squash sponsored by Director, Technical Development, Department of Industries, Government of Bihar, Patna.

Through

C.S.I.R. Polytechnology Transfer Centre, Patna
The study has been completed and the report submitted to the party. A fee of Rs.5000.00 has been charged.

8. Need based short range Regional R&D Problems of Minor Nature.

1) Sweet meat from Soya milk:

Milk sweets are not available/prepared in U.P. due to the ban on splitting of milk during May-July (Summer). Methods are standardized to prepare sweets from Soya milk and demonstrated to two parties in Lucknow. The beany flavour or irritation, are not noticed in the products.

2) Dehydrated flat potato slices or chips:

Dehydrated potato chips loose their flatness and become curled during dehydration. A method is standardised for preparation of flat chips. Flat chips require less space and do not break during transport/export. The process is already released/demonstra ted to one more party on 17-12-1984

3) Process for manufacture of potato flour:

Potato flour manufactured by drum-drying process involves huge initial investment and beyond the scope of small scale industry. A simple process was standardised using indegenous machines. Potato flour obtained can be easily reconstituted with hot water to get mash from which products like tikki, rolls, stuffed parathas, vegetable kofta etc. can be readily prepared. The process is already released and demonstrated to one party.

IV Liaison/Extension activities

(A) Surveys

(1) Survey of Marketable surplus of fruits and vegetables of the region in relation to processing Industries:

A survey was conducted to consolidate uptodate information regarding total acreage and production under important fruits and vegetables and also cereals, non-cereals and oil-seeds of the region. The report has been compiled, which is very useful in drawing future plans.

(2) Survey of Indigenous confectionery:

A preliminary survey to get a first hand knowledge of the method of manufacture, ingredients used for various preparations, e.g. Gajak-sugar based, Gajak jaggery based, Rewri, Chanapatti etc. was conducted.

Samples from different manufacturers were collected and analysed for proximate compositions. Physical observations of each sample were made and studies on moisture sorption behaviour at different humidity levels were also carried out. The findings of the study showed that indigenous confectionery has a very low limit of critical moisture content for a better shelf life and keeping quality. Slight increase in the moisture content render the product unacceptable and hence there is need for suitable packaging of these products to enhance the storage life.

(3) Strawberry

Survey on Strawberries grown in Hilly tracts of U.P.,

A survey was conducted to find out the area under cultivation of strawberry, total quantity produced and their utilisation with a view to ascertain the magnitude of problems of growing this fruit and its utilisation etc.

The main growing areas are Jeolikot and Saur in Nainital District of U.P., total area being 36 hectares with approximate annual yield of 73,000 kgs. There are about 4 hectares in Meerut under this crop with approx. yield of 6000 Kgs.

(B) Processes released and Demonstrations.

(1) Demonstrations of pest proofing of gunny bags using the pest-proofing machine and pest-proofing emulsion developed by CFTRI Mysore were held at grain markets of Lucknow.

(2) The following short term training courses for the entreprenuers were conducted:-

i. Mango Processing Camp Malda, W.Bengal - 18 Trainees

ii) Youth entreprenuers camp at the Birla Industrial and Technological Museum, Calcutta - 6 entreprenuers

iii) Two short term courses of 2 weeks duration each were organised for the lady members of staff of CDRI.

4. Process release and Demonstration:

(3) A total of Five Process releases and demonstrations given already. One more demonstration is planned for 17-12-84 (Annexture I)

(4) An open house discussion was held at SISI Kanpur on Mini Wheat Mill. About 50 prospective entrepreneurs participated in the discussions.

Technical enquiries: A total of 31 technical enquiries in different aspects are attended to (Annexure II).

(C) TECHNICAL ENQUIRIES

168 technical enquiries received from private parties, Government departments/undertakings regarding products and processes developed by CFTRI Mysore were attended to

(D) Analysis of samples:

Analysis of 125 samples of fruit and vegetable products/high protein foods etc. received from various parties/organisations like M/s Modern Bakeries, M/s CARE India were done and an amount of Rs.5900/- realised.

(E) Consultancy Liaison and Extension:

1. Setting up of Fruit Processing Unit at Hazipur: The installation and commissioning of the plant is being coordinated by Lucknow E.S. The main works attended from this Station, apart from coordination, are i) Negotiation with the equipment suppliers ii) Evaluation of tenders and iii) inspection of equipments

2. Status report: A report on the status and scope of food industries in U.P. is prepared. The raw material potentials of food industries and status of food industry in U.P. is discussed and CFTRI Technologies which have scope are identified.

3. Seminar on potato:

   Potato is one of the major and important crops in U.P., but farmers are not getting remunerative prices for the products especially during the glut, which is causing a serious concern to the State Govt. as well as cultivators.

In collaboration with Directorate of Horticulture and Fruit Utilization, a Symposium is proposed to bring the experts from various field together to suggest remidial measure.

The symposium is originally planned for 8-9 October 1984, however postponed due to some sudden administrative changes in the Directorate. It is now planned somewhere in January 1985.

4. Assistance to local industry/organization.

i) Children and Women Welfare Academy U.P., Luck.

-Leaf Cup Centre with 4 leaf Cup Making Machine is started by the academy with the active support of our experiment station in collaboration with PTC. Shri. P.Veerraju inaugurated the centre. Our assistance also includes selection of operations and training them.

ii) M/s Kalpatharu Enterprise, Lucknow

-Leaf Cup Making Machine is being fabricated by this firms at Lucknow with our active support and technical guidance. Shri. P.Veerraju also inspected the firm and advised on many technical matters related to its fabrication. The firms has six orders on hand and many more are expected.

iii) Directorate of Horticulture and Fruit Utilization:

- Assisted the Directorate in selection of candidates for 15 months course in Fruit Preservation, conducted by Fruit Presservation and canning Centre.

5. Economic viability of the Mini Wheat mill in this region:

An economic analysis of the process is conducted taking into consideration the various regional factors and suggestions made to improve its viability. On our suggestion, FMBT had taken up experiments on the technical feasibility of producing Dhalia and Maida along with Atta and Maida.

6. Supply of regional raw materials, products and technical information to Headquarters:

i) 5 kg. of Taramira seeds have been supplied to Dr. Kantharaja Urs, Scientist, P.T. Discipline for conducting R/D work

ii) 4 samples of Dhalia were supplied to FMBT in connection with the work on production of Dhalia and Maida using Mini Wheat Mill.

iii) Information on wheat based Traditional Foods was supplied to FMBT, CFTRI

7. Sales of Books: 48 Books of Homescale Preservation and Processing of Fruits and Vegetables are sold.

8. Enrollment of subscription:
115 subscribers from Lucknow were enrolled for Khadya Vigyan.

9. Regional techno economic news:

Important regional news are compiled and sent to IDCS every month for inclusion in the Bulletin on Techno-economic news.

(E) Papers Published

1) Canning of Waterchestnut (Singhara), (Traps bispinosa Roxb.)
J.Fd.Sci. & Technol. Vol.I No.2-1964.

2) Studies on some important varieties of Green Peas of Northern India I-Physico-chemical compositions.
Indian Food Packer Vol.XXIII, No.6-1969

3) Studies on some important varieties of Green Peas of Northern India II-Canning Trials.
Indian Food Packer Vol.XXIII, No.6-1969

4) Physico-chemical changes during development of Safeda Guava Fruit
Indian Food Packer Vol. XXV, No.1-1971

5) Effect of maturity of Safeda Guavas on flavour preference.
Indian Food Packer Vol.XXV, No.1, 1971

6) Physico-chemical characteristics of Apricot varieties of Kumaon Region and their suitability for canning.
Indian Food Packer Vol.XXV No.2-1971

7) Prevention of pink discolouration in canned litchi.
Jr.Fd.Sci. & Technol Vol.VI,Nov-Dec-1974

8) Determination of optimum maturity of peas for canning for Indian preparations
Indian Food Packer Vo. XXX, No.6-1976

Papers presented at Seminars and symposium

i) A paper entitled "Fruit and Vegetable Processing Industry in Bihar State - presented status and scope for development" was presented in the seminar on Development of Fruit Processing Industry in Bihar held on 31-5-1975 by Shri N.K.Saha.

ii) A paper entitled-
"Effect of ripeness level, storage period, processing conditions and ascorbic acid on flavour

retention in canned Dasheri Mango" was presented in the seminar on 'Mango and its utilisation' at Calcutta on 6-7 March 1976 by Shri N.K.Saha.

(F) Awards.

The paper entitled "Determination of optimum maturity in peas for canning for Indian preparations" published in Indian Food Packer, Vol.XXX No. 6, 1976 was awarded N.N.Mohan Memorial award.

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IV

III. EXPERIMENT STATION LUDHIANA

C.F.T.R.I. EXPERIMENT STATION, LUDHIANA

WORK DONE AT CFTRI- EXPERIMENT STATION, LUDHIANA SINCE 1963

C O N T E N T S

S U M M A R Y

Eversince its inception in March 1963, CFTRI Experiment Station, Ludhiana has concentrated its efforts not only in R&D work but also in transferring CFTRI technology through consultancy, preparation of feasibility reports, demonstrations, etc. R&D work involving investigations on the post-harvest technology of fruits and vegetables, spices and condiments, cereals and pulses, etc. A total of 55 publications comprising research papers, reviews, books etc have been ensued from this Experiment Station. Scientists of this Experiment Stationalso took keen interest in attending and organising symposia/seminars/conferences and presented some 21 papers on these occasions.

Technical assistance has been rendered to several public and private organisations. Techno-economic surveys on various agro-based commodities were undertaken and information consolidated in the form of 20 reports. A process on mechanical dehulling of muskmelon seeds has been released to five parties and a process on improvements of potato wafers quality has been submitted for release.

Scientists of this Experiment Station have also been bestowed with awards and honours including the prestigious NRDC award. Representation on committees, organisation of training/exhibitions, and technical collaboration with other organisations are some of the other activities undertaken by this Station.

A RESUME OF THE WORK DONE AT CFTRI EXPERIMENT STATION, SIMLA/LUDHIANA SINCE ITS INCEPTION (1963 to 1984)

1.0 INTRODUCTION

The CFTRI Experiment Station was initially established at Simla in March 1963. Originally it was called Regional Research Station but later in 1965, it was rechristened as 'Experiment Station'. It was started in a portion of the Naubahar building of the Directorate of Horticulture, H.P., Simla and continued to function there till 1968. Later, it was shifted to Ludhiana in 1969 with the object of serving the food industry in Punjab, Jammu & Kashmir, Himachal Pradesh, Rajasthan and Haryana. At Ludhiana, to start with the Experiment Station was temporarily located in a hired building in Guru Nanak Engineering College. Later, the Punjab Industries Department allocated 5 acres of land on Gill Road, adjacent to MERADO Centre, for the setting up of the CFTRI Experiment Station and constructed a building for the location of the station. It was also furnished by the I-ndustries Department Punjab, with lab. benches, lighting and fans etc. The station shifted to this newly constructed building on 1st February 1971. Realising the importance of this Experiment Station, Punjab Government further sanctioned a sum of Rs.23.5 lakhs to raise a three storey building with necessary pilot plants, demonstration hall and sufficient infrastructure to house the planned expanded activity of the Experiment Station. The building has been up since August 1982.

The CFTRI Experiment Station, Ludhiana is comprised of six laboratories, two pilot plants, two exhibition/prototype machinery display halls, one workshop, library etc. Staff strength of the station as on 1.2.84 was thirty two personnel, 12 Scientific, 7 technical and 13 supporting staff. The additional infrastructure

facilities planned are one generator house, 5 cold rooms, new pilot plant equipments and analytical instrumentation for the laboratory. It is further planned to enhance the staff strength to 100 by 1988-89 in phased manner.

MAIN ACTIVITIES AT EXPERIMENT STATION, LUDHIANA

Experiment Station, Ludhiana is committed to perform the following activities in order to widen the scope of raw material utilisation and food based industries in the region.

a) To study the suitability and quality characteristics of different varieties of various agro-horticultural crops of the region namely, fruits and vegetables, cereals, oil seeds and spices.

b) To conduct investigations on the problems of the industry and advise for new products for the existing industries in the region.

c) To establish closer technical liaison between industry and research and offer advice in planning and setting up of new food industries.

d) To act as an extension centre of CFTRI, Mysore to make available the technical know-how of the processes and products developed at the CFTRI, Mysore to the industries and entrepreneurs for the quick utilisation of the Institute's research findings.

e) To conduct surveys to identify R&D problems for research.

f) To become a co-ordinating link between the CFTRI and the State Government agencies in formulating food policies for the development of new food industris in the region.

2.0 RESEARCH & DEVELOPMENT WORK - COMPLETED

2.1 Post-Harvest Technology of Vegetables

2.1.1 Studies on the suitability of different varieties of potatoes for canning.

Canning trials were carried out on 4 potato varieties namely up-to-date, Criage Defiana, Salthu and Dhankri. Disintegration was rather high in all the varieties (100%, 78%, 65% and 12.5%) respectively). Criage Defians and up-to-date varieties were markedly superior to Sathu and Dhankri varieties in organoleptic quality. Grading of potatoes on the basis of specific gravity (by brine flotation procedure) indicated a low disintegration in potatoes of specific gravity close to 1.075. Calcium treatment did not have any significant effect on texture or disintegration of any of the varieties tested.

2.1.2 Standardization of a method for processing of canned 'Sarson-ke-saag' in curried form:

At the request of MARKFED Canneries, Jullundur, studies were undertaken for determining the optimum stage of maturity of the mustard green (sarson-leaf) for defining the processing conditions and the development of recipe for canned curried sarson-ka-saag. The canning process has been developed and already released to the industry. A common acceptable recipe was standardized with the help of a taste panel. The product was acceptable even one year after canning. To prevent discoloration of the plain can by sulphur contained in the material, a modified 'Protect-tin-process' was adopted with success. Based on the method standardized, Jullundur canneries are packing sarson-ka-saag in curried form for both the internal market and export. Haryana Agro-Industries exported canned sarson-ka-saag

worth Rs.4 lakhs in 1981 while MARKFED has been exporting worth Rs.2 to 3 lakhs every year. There are bright prospects for this product both for internal consumption and export.

2.1.3 Standardisation of conditions for steeping preservation of cauliflower for the manufacture of sweet mixed pickle.

The mixed sweet pickle of cauliflower, turnip and carrot suffers from defects like loss of texture, discoloration and fungal spoilage during storage. In order to improve the existing manufacturing process, firstly, a generally acceptable recipe was standardized. Proper blanching of the raw material was necessary to retain the texture satisfactorily. Exclusion of tamarind helped in better retention of colour in the product, acidity level of 1% was found to be optimum both for taste and preservation. Use of lemon juice and citric acid in place of acetic acid improved the quality of pickles.

Availability of raw materials for manufacture of pickles is limited to a few months. To help in extending their availability over a longer period of time, a bulk preservation technique for raw materials was developed using brine solutions containing acetic/citric acid and KMS. Cauliflower curds retained good texture and colour over a period of six months when preserved in 12% brine containing 0.25 - 0.5% acetic/citric acid and 750 ppm SO_2. Thus preserved product will find use not only in the pickle manufacture but also in the retail sale over the counter during off seasons and in the catering trade.

2.1.4 Studies on incidence of spoilage in Carrot Murrabba:

Spoilage of carrot murrabba is a common complaint

in the preserve industry. Studies taken up at the Station showed that the main reason for the spoilage was inadequate time given by the industry to attain equilibrium between the solid carrot pieces and the steeping syrup. The industry tries to finish the whole operation within 24 hours by a two-stage process. Other improvements suggested are (1) addition of citric acid at 0.1% level to check crystalisation of sugar, which is common in commercial samples and (2) use of 50% sugar syrup in the initial stage instead of dry sugar as practised at present, to prevent shrinkage of carrots. Addition of permissible dose of preservative and packing the finished murrabba in air tight containers checked spoilage completely. These findings have helped to improve the product and overcome the common problem of spoilage in carrot murrabba.

2.1.5 Screening of pea varieties developed by the Punjab Agricultural University, Ludhiana for canning and dehydration.

Of the eleven varieties of peas supplied by the Punjab Agricultural University, the following varieties were found to be suitable for canning: Perfection New Line, G.C.141, P-35 and Bonneville. The factors taken into account to assess the suitability were colour, texture, uniformity, taste, flavour and absence of defects.

In the overall assessment of pea varieties for dehydration purposes, the variety P-35 ranked first closely followed by Multi-Freeze, Perfection New Line and Lincoln. The results have been communicated to PAU to enable them to make suitable recommendations to the cultivators in the region.

2.1.6 Screening of tomato varieties developed by the Punjab Agricultural University, Ludhiana for their suitability for processing (canning and juice manufacture).

Quality of canned whole tomatoes and tomato juice depends largely on the variety of tomatoes besides other processing factors. At the request of Punjab Agricultural University (PAU) Ludhiana, twenty four varieties of tomatoes under performance studies at the PAU were assessed for their canning and juice making qualities so that the PAU could incorporate this aspect in their recommendations. Variety EC 55055 was observed to be the most suitable for canning on account of its good texture, colour, taste and flavour, higher drained weight and the convenient size of fruits followed by EC 55054 and Chicko Grando.

Of the nineteen varieties of tomatoes for juice making, Punjab Tropic was the most suitable because of its excellent fluidity, taste, flavour and oolour, with variety Keck Ruth Agethi standing second. The recommendations have been passed on to PAU for use in their varietal improvement work.

2.1.7 Screening of new varieties of cauliflower, onion and lady's finger developed by PAU Ludhiana for assessing their quality characteristics and suitability ffor processing.

Cauliflower varieties: Five varieties of cauliflower, namely S-35, S-35A, S-26, Giant-Snow Ball and Improved Japanese varieties obtained from the PAU were analysed for physico-chemical characteristics and were later canned and dehydrated to determine their suitability therefor. The physical data on growth, yield, disease resistance and other economic characteristics collected by PAU members have been incorporated in

this report. The cut-out examination of the canned cauliflower did not show any significant differences between the varieties except for S-35A which had better texture and colour. Experimental packs having added ascorbic acid @ 0.12% to the covering brine yielded slightly better coloured product. Ascorbic acid losses in canned cauliflower were 40.4 to 50.8% after one month storage and 70-80% during 12 months' storage at room temperature (13-38°C). The variety S-35 which had a higher yield per hectare than that of S-35A, was the next best.

The dehydration ratio ranged from 9.7:1 to 10.7:1 in different varieties. The dehydrated Giant Snow Ball variety reconstituted to its original shape reasonably well followed by Improved Japanese variety. The rehydration co-efficients of Giant Snow Ball and Improved Japanese were 56.2 and 54.7% respectively, as compared to 51 and 54% for the other varieties.

Okra Varieties: Twelve new varieties of okra (Lady's finger) developed by Punjab Agricultural University were also screened for their physicochemical characteristics as well as for their suitability for canning and dehydration. Protein content appears to be correlated with number of ridges and number/weight of seeds. The higher the number of ridges or seeds, higher the protein content. All varieties were rather poor source of ascorbic acid. Grading of okra prior to canning yielded much superior product of uniform quality. The variety Pusa Sawani was found to be the best for dehydration and the variety Vaishali Vadhu for canning purposes.

Bitter gourd varieties: Four new varieties of bitter gourd or Karela(BG-12, BG-13, BG-14, G-98) obtained from PAU, were analysed for proximate composition.

Their suitability for canning and dehydration was also tested. There was no significant variation in protein content among the varieties, which varied from 14.9% in G-98 to 15.6% in BG-14 variety on dry weight basis. The sugar content was found to be low in all the varieties. The ascorbic acid content varied from 77.2 to 60.0 mg/100 g in different varieties of bitter gourd. These varieties were also tested for their suitability for canning and dehydration. The variety BG-12 gave the highest drying ratio(6.6:1) followed by variety BG.14 (8.6:1). Variety BG-14 scored the highest points in canning and dehydra tion studies, mainly due to their superior colour and texture. The dried product of BG-14 reconstituted to its original shape reasonably well and had good acceptance score.

2.1.8 Studies on varietal suitability of tomatoes for ketch-up manufacture.

At the request of the Punjab Agricultural University, seven varieties of tomatoes, namely Punjab Kesari, Punjab Chhuhara, Keckruth Agethi, S-12, Pusa Ruby, Pb.Tropic and Selection 120 were screened for their suitability to manufacture tomato ketchup. The juice recovery was 77% in Pb.Tropic, 75% in Keckruth Agethi, 74.5% in Pb.Kesari 72.5% in Pb.Chhuhara and 73.3% in S-12. The last two varieties were found to be the best with respect to colour, consistency and flavour. Pusa Ruby, Kedkruth Agethi, S-12 and Selection 120 had 5% soluble solids. During the preparation of ketchup the loss in ascorbic acid ranged from 17.2 to 74.4% in different varieties. Pb.Chhuhara, Pusa Ruby and S-12 are well suited for ketchup manufacture with respect to colour, viscosity and overall quality attributes of ketchup. The finished product stored well at room temperature (13-38°C) for 12 months and at low

temperature (5-7°C) for 15 months. Colour loss in ketchup ranged from 39.2% (Pb.Tropic) to 58.6%(Selection-120) with maximum retention in S-12

2.1.9 Standardization of conditions for steeping preservation of fresh vegetables suitable for Indian style cooking.

Studies on the determination of optimum conditions of steeping preservation of eight vegetables viz., cauliflower, turnip, carrot, cabbage, peas, okra or lady's finger, squash melon (tinda) and bittergourd (Karela) were undertaken. Different concentrations of common salt (10,12,14, 16 and 20%) organic acids (0.1 to 1%) and sulphur-di-oxide (350 to 700 ppm) were used for this purpose. Changes in salt, acidity, sulphur-di-oxide, pH and other important nutrients were recorded in order to determine the optimum conditions of preservation of each summer and winter vegetable tested.

Optimum steeping conditions for cauliflower were found to be 14% brine containing 0.25% acetic acid and 700 ppm sulphur-di-oxide; for carrots, 14% brine containing 0.25% citric acid and 700 ppm sulphur-di-oxide. For bittergourd (karela) and lady's finger(bhindi) respectively, 10% brine with 0.5% citric acid and 700 ppm sulphurdioxide and 10% brine with 0.5% acetic acid and 700 ppm SO_2 were found to be optimum. Cabbage can be preserved nicely in 12% brine containing 0.5% citric acid and 700 ppm sulphur-di-oxide, while squash melon (tinda) can be preserved in 15% brine containing 0.5% acetic acid and 350 ppm sulphur-di-oxide. The optimum conditions for green pea pods (whole) were found to be either 5% brine containing 1.2% acetic acid and 300 ppm of sulphur-di-oxide or 20% brine containing 0.5% acetic acid and 350 ppm of sulphur-di-oxide.

Though cauliflower, turnips and carrots could be preserved successfully by this simple technique for over 12 months at room temperature(13-38°C), the optimum storage period recommended is only 9 months leaving 2-3 months for sale/disposal. Other vegetables like squash melon, bittergourd, okra, cabbage and peas can be preserved easily for a period of 6 months in good conditions.

Bulk preservation of vegetables in different concentrations of brine, acid and sulphur-di-oxide using polyethylene lining in 16 kg tins was also studied. Vegetables kept in good conditions in respect of colour, texture and general appearance even after six months' storage at room temperature though their flavour was somewhat weaker. During bulk storage, changes in nutritive value were noted with special reference to leaching of sugars, protein and loss of vitamins.

In order to determine the optimum conditions for leaching out of excess salt and acidity in thus preserved vegetables for ultimate utilisation in the preparation of curried vegetables, various techniques were tried viz., wasing them in hot water, cold water, running tap water, neutralisation of excess acid with required quantity of sodium bicarbonate solution, etc. Running water was adjudged to be the best and the simplest technique. Optimum leaching time for cauliflower, bittergourd, cabbage, carrots, lady's finger and squash melon was found to be about 2.0 hours in each case, while turnip and peas required 2.5 hours. Indian style curries were prepared out of these vegetables and found to be quite acceptable. The quality of these vegetable curries was quite close to those prepared from fresh vegetables except for flavour

which was somewhat weaker in preserved vegetables. Pakoras and samosas can also be successfully prepared from the leached vegetables. This simple preservation technique will help in extending the availability of vegetables, avoid glut and maintain market prices.

2.1.10 Studies on the maintenance of whiteness and extension of shelf life of cultivated and naturally occurring mushrooms by steeping and other methods of preservation.

The Punjab mushroom growers and the Punjab Agricultural University Ludhiana are facing acute difficulty in the maintenance of whiteness in mushrooms and greying of tropical mushroom even during few hours of keeping after harvest. They are also interested in the extension of shelf life of fresh mushroom by a suitable simple technique in order to enable them to transport mushrooms to the terminal markets like Delhi etc., where mushrooms fetch premium price. The present investigations were undertaken to solve the above industrial problems as follows:-

Proximate chemical composition of mushrooms (Agaricus bisporus)and Volvareilla volvacea) was determined. It showed that mushrooms are a good source of proteins. Mushrooms were preserved by steeping in an aqueous solution in order to maintain the whiteness and to extend the shelf-life. Various concentrations of acetic acid, ascorbic acid and potassium metabisulphite were utilised for steeping preservation of mushrooms. Water blanched mushrooms steeped in 0.25% citiric acid, 500 ppm SO_2 were the best one. Mushrooms can be steeped in this solution for a long period of one month without loosing much flavour and texture. To maintain whiteness H_2O_2 was found more effective. Curries prepared from

fresh and steeped mushrooms compared well in respect of colour and texture. However, flavour was slightly mild in steeped mushroom curry. Technical data on dehydration of mushrooms were also collected. Microbial growth on mushrooms (washed and unwashed) and steeped solutions was studied.

2.1.11 Studies on the utilisation of potatoes in the production of instant mashed potato 'tikki':

Potato tikki is a popular snack food in North India but there is no published information on its manufacture, chemical composition etc. There are two types of tikkies viz., (i) stuffed with Mung dal and/or green peas, etc. and (ii) plain unstuffed). Proximate analysis of commercial samples showed moisture variation from 64-66%, either extractives 7-8%, protein 6-18% in stuffed and 2.5% in unstuffed tikkies. Trials were conducted on standardization of tikki making processes on lab. scale to assess the requirements. For developing a simple technique for preparation of dried mashed potatoes, cooked potatoes were dried in mashed and sliced forms. The drying ratio was 6:1. The reconstitution ratio was low (1:3:5). Rehydration was quicker in the case of blanched and dried slices than in fully cooked dried slices. Dried slices when reduced to -64, +64 and -32 mesh exhibited sticky texture. This was also noticed in the drum dried powder but retention of flavour was better in this case than in dried slices. Thickness of slices affected the reconstitution and consistency of potato dough required for tikki making; 1 mm thickness was seen to be optimum.

2.1.12 Technological assessment of new varieties of fruit and vegetables developed by PAU/HAU/ HPAU for their quality characteristics and their suitability for processing in different forms.

Four varieties of muskmelon, two of watermelon, eight varieties of green chillies, five varieties of okra seeds, four of green peas, three of brinjal and six varieties of garlic obtained from the Punjab Agricultural University were assessed for their suitability for processing. All the varieties of these vegetables had been assessed for their physico-chemical characteristics for their suitability for processing. The work has been completed successfully. Out of the four varieties of muskmelon, the variety Punjab-sunehri was adjudged the best for canning followed by M.F. in respect of texture, colour, taste and flavour. Watermelon juice, with 0.2% added citric acid, of both the varieties was found quite acceptable. For dehydration of green chillies, addition of sodium carbonate in the blanching solution improved the colour of the dehydrated and rehydrated chillies in all the varieties. Out of five varieties of okra seeds, the seeds of variety L-Sel-1 contained the highest protein (20.1%) followed by L-Sel-2 and the seed of Pusa Sawani variety was higher in oil content (24.6%) followed by L-Sel-1(18.6%) on moisture free basis. Two varieties of peas namely P-87 and P-88 have been adjudged TO BE THE BEST FOR DEHYDRATION AND CANNING. Dehydration of brinjal either after baking or blanching and then dipping in KMS solution has been found to be acceptable in respect of colour, flavour and general appearence. All the six varieties of dehydrated garlic powder appear to be good in respect of colour and flavour.

2.1.13 Improvement in the quality of potato waffers:

Trials were conducted on the manufacture of potato waffers from freshly harvested potatoes and those stored over 6 months in cold storage from two well identified varieties viz., Kufri Chandramukhi and Kufri Sheatman. A combination of hot water and chemical treatment was worked out which gave potato waffers of completely white colour irrespective of the variety and age of the potatoes. Usually waffers can be made only from fresh potatoes. A procedure was worked out to get waffers even from dried potato slices. This will provide a continuous raw material at stabilised prices to waffer industry and would also promote the growth of dehydration industry. Oil consumption in the preparation of waffers prepared from dried slices was a lso considerably less (10-15%) and the frying time was cut down by 50% under identicial conditions.

2.1.14 Studies on manufacturing, packaging and storage of some new products formulated from potatoes:

Experiments were conducted on preparation of different products from potatoes. Potato papads were prepared from both new and old potatoes by incoration of starch and different spices. Potato sewian were prepared by incorporation of besan and Khasta product were prepared by incorporation of starch and spices. All the products thus prepared were found to be good in colour, taste, flavour, etc. Physico-chemical analysis of raw potatoes and the products were carried out.

2.2 Post-Harvest Technology of Temperate Fruits:

2.2.1 Assessment of the suitability of different local varieties of apples for the manufacture of apple juice, apple sauce and apple rings.

In order to maximise the utilisation of various apple varieties of Himachal Pradesh, studies were carried out to assess the suitability of unimportant varieties of apple and cull fruits for preparing juice, apple sauce either alone or in blends and as apple rings (dehydrated).

26 varieties of apples for apple juice and 29 varieities for apple sauce were screened for juice and sauce manufacture. Their quality was evaluated by taste panel studies. The varieties Golden Delicious, Baldwain and Rus Pippin were found to be better in overall charcteristics for juice and sauce. The sauce with brix-acid ratio between 50-78, soluble solids between 18-22% and acidity as malic between 0.28% and 0.39% was found to be most acceptable to the taste panels. The results of blending cheap cooking varieties with better and expensive varieties such as Golden Delicious and Rus Pippin indicated the likelihood of reducing the cost of production upto 25% level.

Out of the several combinations of sulphiting and blanching treatments tested as pre-treatments for dehydration, it was found that the lot treated with 1% acidified potassium metabisulphite solution and dried to 50% reduction in weight followed by 2 minutes steam blanching (DBD) followed by drying to 9.85% moisture was the best. The resultant product reconstituted very well and had typical apple rings prepared from different varieties was: Golden Delicious (DBD), Kind Pippin (sulphitation) Red Delicious (DBD), Rus Pippin (Sulphitation) and Baldwin (Sulphitation).

2.2.2 Studies on canning of Himachal Pradesh apples-varietal trials.

Canning of Himachal Pradesh apples in the form of rings was investigated. Of the four varieties tested, Red Delicious, Golden Delicious, Rus Pippin and Summer Queen canned in 40% sugar syrup, Red Delicous was found to be the best followed by Rus Pippin, Summer Queen and Golden Delicious. A 40°brix covering syrup was found satisfactory in the case of Red Delicious and Rus Pippin and 58°brix in the case of Golden Delicious. This work opened up new avenues of utilisation of apple for getting highly acceptable product.

2.2.3 Determination of optimum picking maturity, handling, packing, transportation and storage conditions for important varieties of apple of H.P. and J&K

In view of the increasing production of apples in the last few years in the two states, J&K and Himachal Pradesh and the consequent problems in handling, transportation and storage, work was undertaken on the reque of J&K Government to fix optimum stage of maturity in the different varieties of apples and to determine the most optimum conditions for transportation and storage. Physicochemical changes in the developing fruits of varieties Red Delicious, American Apirouse, Maharaji and Kesari were studied with a view to determine indices for fixing maturity to study the ripening pattern and storage life at ambient and low temperature(32°F) and to determine the optimum packing maturity for storage of the fruits harvested at three maturities. As the agro-climatic conditions are known to have a definite effect on the maturity and quality of the fruits, four locations were selected (Narbal and Chnarisherief in the Srinagar Dist., Shopian in Anantnag Dist. and Wodura in Baramula Dist. of J&K State

The fruits of Narbal and Wodura exhibited similar maturity pattern. Fruits from Chrarisharief attained corresponding maturity 15 days earlier and the fruits from Shopian area took a further fortnight more to attain maturity than the fruits from the plains (Narbal and Wodura). The optimum maturity was reached between 142-150 days in Red Delicious and American varieties, 127-132 days in Kesari and 155 to 180 days in Maharaji variety during the 4 years of the study. The fruits harvested at this stage, when ripened, showed maximum dessert quality for the variety and could be stored with minimum storage disorders and longest storage life (7 months for Red Delicious and 4-5 months for Kesari). Apples harvested 15 days later (than the optimum maturity) were considered of late maturity, since although still satisfactory for picking, they became somewhat poorer in flavour and showed slight tendency to become mealy and develop disorders associated with over maturity during storage.

It was also seen that the period from full bloom to maturity alongwith the starch iodine reaction are the most reliable indices of maturity of apples and can be used in conjunction with other indices such as pressure tester reading, seed colour and total soluble solids.

These studies would be of great help to the growers and commercial traders in assessing the right picking maturity for dessert and cold storage purposes.

2.2.4 Development of improved method machinery for processing walnuts:

The performance tests on the equipments developed by CFTRI for the post-harvest processing of walnuts were conducted at Shopian near Srinagar in J&K. The main results of the collaborative studies with P.D.Discipline are as under:-

Conditioning platform : Early desiccation of walnuts was observed in the bottom layers during conditioning. Later, the ground clearance was reduced to only 3" instead of 18". This prevented desiccation as well as rotting of fruits. The conditioning of fruits was uniform and the hull losening was also uniform in all the fruits in each batch.

Hulling: The centrigugal pulper was modified to have larger dicharge and more clearance of the bottom tray. This improved both the separation of the hulls from the nuts as well as breakage of nuts. Pulper type huller was modified by reducing the number of abrasion knives as well as incorporating the modified paddle. The hulling efficiency was no doubt improved but the breakage of nuts was more.

Mechanical separation of hulls: To separate the hulls from the nuts, vibrator screen was used with success.

Washer: Hand-operated washer, designed at the Institute, was successfully used for the washing of nuts. The washer, which has a capacity of 10 kg per batch, could wash the nuts in five minutes.

Live demonstrations: Live demonstrations of the washer were given at four walnut processing units/ at Shopian (about 50 kms from Srinagar). In one processing unit, more than half of the nuts (40,000 nuts or 1 ton FWB) were washed by this machine. After dehulling and washing, the net recovery of nuts was about half a ton. Live demonstration was also given to several State Government. Officers notably the Managing Director of APPMC, Jt. Director of Industries, J&K Government

2.2.5 Semi-commercial trials on the transport and storage of apples from Himachal Pradesh and Jammu & Kashmir.

In order to improve the trade practice for transportation, Packaging and storage of apples, semi-commercial scale trials were conducted. Apples of 4 commrcial varieties, namely, Golden Delicious, Royal Delicicus, Red Delicious and Richard packed with conventional and improved packing materials were transported from Himachal Pradesh to Ludhiana and stored in a commercial cold store. These studies led to the following findings: (1) The percentage bruising is high in conventionally packed Royal Delicious apples ranging from 54.6 to 74.1% depending upon fruit size. In large and medium fruit conventionally packed, bruising ranged from 62 to 74% and in small fruits it was around 55% (2) Improved method of packaging (use of corrugated Cardboard as partition material and as case liner) reduced bruising considerably in large and medium sized fruits (from 61.8 to 38.9 and 74.1 to 38.1% respectively). This beneficial effect of improved packaging was not seen in small and extra small fruits (3) fruits packed by modified conventional method but with corrugated cardboard lined boxes instead of newspaper also reduced bruising in medium size fruit (43% bruising against 74% in conventionally packed fruit). (4) The physiological losses in fruit weight during storage were also related to fruit size. Smaller fruits lost more wight and shrivelled faster than did the bigger sized fruits, (5) Waxing of the fruits prior to storage considerably reduced the physiological loss in weight and fruit shrivellage, (6) Among the four commercial varieties studied, Golden Delicious exhibited more shrivellage and it storage life, under

commercial storage conditions, was found to be only 3 months (September - November) for small and extra small size grades and 4 months (September-December) for large and medium size grades. The other three varieties (Royal Red and Richard) exhibited wastage due to dcay and shrivellage of less than 10% upto the end of December. No clear pattern emerged regarding decay of fruits during storage since neither the fruit size nor the method of packaging seemed to have any effect on fungal infection/decay. These observations will possibly help the fruit growers and commercial traders in overcoming the various problems confronted during transportation and storage of apples.

2.2.6 Studies on the post-harvest physiology of minor temperate fruits during repening and subsequent storage a t room temperature and at low temperature:

With the object of determination of optimum stage of maturity for harvesting of pears from Jammu & Himachal Pradesh and peaches from J&K, changes in physiochemical characteristics of the fruits of each of the two commercial varieties of pear (Bartlett and William) and of peaches (Elberta and Quetta) during storage at room temperature(30-35°C) and at low temperature (2-5°C) have been studied. The fruits were harvested at 4 stages of maturity, transported to Ludhiana and ripened at room temperature (30-35°) and at low temperature (2-5°). Effect of fruit maturity on ripening pattern was studied. The fruit pressure decreased gradually during maturation while browning of seeds progressed during maturation. T here was an increase in concentration and progressive fall in acidity with the advancing maturity.

Fruits from different harvests revealed that fruits of III maturity of William pear (J&K),

II maturity of William pear(HP) and I maturity of Bartlett pears were best in quality.

Waxing at low temperature prolonged the storage life of pears by about 2 weeks but this effect was not apparant at room temperature. Waxing had no significant beneficial effect on peaches even at low temperature. Further waxing of peaches with 3%,6%, 12% wax emulsion with the widely fungicides (Aureogungin and Bavistin) and hot water treatment were tried. All these treatments had no significant beneficial effect on peaches even at low temperature. However, comparatively, 3% wax coating gave better appearance of the fruit than all other concentrations of wax emulsion tried. Control lots of peaches of 2 varieties namely Elberta and Quetta were adjudged as the best in all respects. Free stone Elberta variety was also canned at the end of their normal storage life. Canned pears kept excellent while canned peaches were satisfactory.

2.3 Post-Harvest Technology of Tropical and sub-tropical fruits:

2.3.1 Semi-commercial scale trials on transportation of 'Anab-e-Shai' grapes:

Semi-commercial scale trials were conducted on the effect of inpackage fumigation of Anab-e-Shai grapes during transportation from Hyderabad to Ludhiana. On arrival at Ludhiana the grapes were examined with respect to various quality parameters. Subsequently, the treated and untreated grapes were sold in the Ludhiana fruit market through normal trade channels. The results showed that inpackage fumigation of grapes was very effective (a) in reducing the berry drop (b)reducing fruit decay from 25-40% to less than 5% (c) in checking the discolouration of fallen barries

at stem end and (d) helped in the retention of freshness of fallen berries as well as whole bunches. The overall superior quality of inpackage fumigated fruits was also reflected in better sales return profits fetched by treated grapes than control during the auction sales at Ludhiana.

2.3.2 Studies on the utilisation of five varieties of sub-tropical peaches grown in Punjab.

Five varieties of peaches considered to be suitable for growing in the plains of Punjab and grown by the Punjab Agricultural University, Ludhiana were studied for the preparation of various products. Varieties Elorda sun, 16-33, Early Amber, Sun Red and Florda Red were found to be good for jam. The first four varieties were also suitable for squash and nectar, whereas the varieties Early Amber, 16-33 and Florda Red were found to be suitable for canning purposes.

2.3.3 Studies on the utilisation of subtropical pear varieties of Punjab for various products:

Three varieties of pears, Leconte, Smith and Stone pear (Nashpati) suitable for growing in the Punjab region were assessed for their physico-chemical characteristics and suitable for conversion into processed products. All the varieties gave good quality jam and chutney. The stone pear was found to be quite suitable for manufacture of clarified juice.

2.3.4 Utilization of local varieties of grapes of Punjab.

As the instance of grape orchardists of Punjab, the feasibility of producing clarified juice and squash from locally cutivated Black Prince and squash from Kandhahar varieties was examined. The squash from Kandhahar variety sedimented quickly in 4-5 days and the

juice could be syphoned and re-bottled to yield a clear, sparkling product, which remained well for 6 months without any deterioration in quality, taste and flavour. This product was found to be superior to that from Black Prince variety.

2.3.5 Industrial utilization of malts oranges(Citrus Sinensis Osbeck):

In order to prepare malta orange juice concentrate and other products from malta orange grown in Punjab, about 3,500 malta oranges were despatched to CFTRI, Mysore in two consignments by Punjab Agro Industries Corporation Ltd., for Pilot Plant studies. Malta orange juice had 10-11°brix, acidity 0.6-0.7% and vitamin C50-60 mg/100 g. It gave palatable R.T.S. beverage and squash.

Kinnow oranges (cross between malta and mandarin) were procured from Regional Station, Department of Horticulture, P.A.U. Ludhiana. Technological data for juice, peel and pomace were determined. The recovery of juice was 58%, peel 26% pomace 15% and 3% mechanical loss. Medium and small oranges yielded slightly higher juice content (57-60%) than large oranges (52%). The juice had 12°brix, good ascorbic acid content almost like malta orange juice (42 mg/100 g), 0.85% acidity (as citric acid). Essential oil of fresh peel was determined as 0.75 to 1.60%. Viscosity of fresh juice was 8 centipoises.

Knnow orange juice was processed into ready-to-serve beverage using 10% juice, 0.3% acidity and 14° brix and squash. Both the products were found quite acceptable. The concentrate prepared by vacuum concentration method and storage studies were conducted at RT (30-40°C) and LT (4-8°C). Vitamin-C losses were 30.2%

at RT and 19.5% at low temperature over a period of 6 months storage. A decrease in viscosity was also noticed during storage.

2.3.6 Hot water treatment of mango (Dussehri and Langra)

The two most important commercial varieties of mango (Langra and Dussehri) were collected at the commercial maturity from the orchards near L udhiana. The fruits were given hot water treatment at 33 ± 1°C for 4-5 minutes. Fruits were then stored at 34-36°C(RT) and R.H. 52-80%. The spoilage was reduced by 50% in Langra variety but no effect was observed in Dussehri variety. The ripening in Dussehri and Langra varieties was increased on 6th day. In Langra variety, control fruits looked better in appeara nce than blackish spotted treated fruits. No significant changes were noticed in control and treated fruits in respect of T.S.S. pH and acidity in both the varieties.

2.3.7 Storage behaviour of unprocessed mango pulp and juices-trials on mango pulp/juice canning eliminating the retorting step:

In order to eliminate thermal processing of pre-pasteurised and hot filled canned mango pulp, samples of canned mango pulp were drawn from the usual commercial production line of M/s Haryana Agro Food and Fruit Processing Factory, Murthal, at two stages of processing viz., (1) pulp boiled for 5 minutes hot filled, cans sealed, and left as such without any further processing, (2) cans filled as in (1) and further processed for 40 minutes at 1 lb pressure. Storage studies at R.T. (30-40°C), revealed no difference in their quality upto 180 days storage. The unprocessed pulp had no signs of spoilage even after 180 days storage indicating enormous potentials of energy saving usually spent in processing of sealed cans.

2.4 Technology of Spices and Condiments:

2.4.1 Studies on the technological assessment of quality of different varieties of chillies grown in Punjab, Haryana, Jammu and Kashmir and Himachal Pradesh.

Over fifty varieties and types of red chillies were collected from four states, namely, Punjab, Haryana, Himachal Pradesh, Jammu & Kashmir and assessed for the physical, chemical and technological quality characteristics. Chillies from Rajpura and Sunam in Punjab and from Murthal Pataudi and Hissar in Haryana were characterised as good based on their pericarp, normal pod seed ratio, medium size, bright red colour and Pungency. The samples from Pampore and Noorbagh area in Kashmire possessed deep red colour, normal pod seed ratio, medium/large fruit size and moderate pungency. Among the new varieties of Punjab Agricultural University Selection 116-S, Jawala and Selection 66-3-10 could be regarded as good varieties from the point of view of total extractable colour and capsaicin content or oleoresin. In chillies grown in Himachal Pradesh, maximum capsaicin content was recorded in Tikki, closely followed by Jurg, Gatlo and GhandaiII, while colour was the highest in Kayrigudda closely followed by Jurg sample.

2.4.2 Studies on technological assessment of quality of ginger grown in Himachal Pradesh:

The ginger grown in Sirmour area of Himachal Pradesh was assessed for physico-chemcal characteristics and also for sun drying and dehydration. It took 24 hours for dehydration of unpeeled ginger, 20 to 22 hours for the peeled ginger and only 5 hours for sliced (1/8 cm thick) ginger. The drying ratio was of the order of 5.9:1 to 6.7:1. It took nearly 2 days to dry sliced ginger in the sun and 8 days for peeled ginger. Himachal ginger was a fair source of essential oil (1-2%) and oleoresin

(4.9 - 6.5%). Bleaching or coating of ginger with lime solution (Calcium hydraxide solution) improved its colour and appearance. It was somewhat inferior to Kerala ginger but superior to ginger grown in other hilly areas.

2.4.3 Screening of new varieties of white onions (developed by PUA) for dehydration purposes:

Six varieties of white onion, namely L-24, L-131, Pb-48, L-257-9-1, L-106 and UD-102, one of yellow (Texas Yellow Grano) and one of red onion, punjab Selection, obtained from PAU, Ludhiana were analysed for proximate composition and assessed for suitability for dehydration. The averag size of Punjab Slection onions was found to be the largest followed by Pb-48. The flavour of various varieties varied from medium to strong. The total solids in Texas Yellow Grano variety were quite high followed by Pb-48. Among the six white varieties of onions tested, Pb-48 ranked first in respect of total solids. However, the maxium pungency as measured by pyruvic acid content was recorded in L-131, followed by L-257-9-1. The other varieties could be regarded as mildly pungent. Drying ratio in different varieties of white onion ranged from .7:1 to 8.4:1. The yield of dried product among the white varieties was the highest in Pb-48, and minimum in L-196 and UD-102. The moisture in dried rings ranged from 3.1 to 3.7%. The rehydration ratio varied from 1:5.0 (L-257-9-1) to 1:6.0 (L-124). During 12 morth's storage under ambient condtions, the pyruvic acid losses ranged from 55.5% in L-131 to 77.6% in L-257-9-1. Variety L-131 scored the highest points followed closely by Pb-48 and L-124. The same are recommended.

2-4-4 Utilisation of wild and cultivated pomegrantes for the manufacture of 'Anardana':

Wild pomegranates are covering vast areas of hill slopes of Jammu Province of J&K, parts of Chamba, Kangra and Mandi Districts of Himachal Pradesh and sub-mountaineous areas of Punjab.

13 samples of 'Anardana' purchased/procured from Jammu, Batoto, Reasi, Udhampur, Simla, Amritsar and Ludhiana, were analysed for chemical composition. Moisture ranged from 5.35% to 14.7%. Acidity was found quite high in all the samples (9.8 to 12.20%). Ether extract ranged from 0.4% to 0.84%. Total sugars were also quite high ranging from 14.4% to 17.5%. Protein was 4.74 to 6.25% which was determined only in 3 samples. Crude fibre was too high ranging from 41.8 to 55.4%. Total ash as well as acid-insoluble ash ranged from 2.45 to 4.04 and 0.75 to 1.98% which may be due to dust entering during sun-drying and storage of 'Anardana' in the traditional way. Calcium content ranged from 36.8 to 56.4 mg/100 g.

The packaging requirement of 'anardana' were determied by Wink's Weight Equilibrium method of sorption isotherms. The Equilibrium Relative Humidity (ERH) of Anardana at i.7% moisture was found to be 65%. No mould attack was seen at 90% RH and 47.25% moisture upto 9th day but the mould appeared on 10th day at moisture level of 49%. There was no material change in colour in Anardana during storage at different relative humidties during ERH studies.

'Anardana' at 10.8% moisture level was packed in polythene bags (100 gauge), capped glass jars and friction top tins and stored under ambient conditions. During 6 months storage in polythene bags changes

in moisture, acidity and discoloration were observed. However, there was no material change in moisture in glass and tin containers though discolouration/darkening was noted.

2.4.5 Chemical composition and utilisation of wind fallen green mangoes for the manufacture of 'Amchu

Green mangoes are used mostly for the manufacture of pickles and chutneys and are also used to manufacture of 'Amchur' which is used as an acidulant in curries and sold after packing in polythene bags and in cardboard cartons. There are no quality standards prescribed either by ISI or PFA. The present work was undertaken to cover this gap.

Thirty commercial samples manufactured in different areas of Punjab, Delhi, Gujarat, Rajasthan, alongwith 5 authentic samples prepared in the pilot plant were analysed for the extent of variation in their physico-chemical characteristics. Considerable variation was recorded in the various physico-chemical characteristics of all the samples. The commercial samples were found to have much higher added common salt (NaCl) content and crude fibre, reducing sugars and total sugars. Further, commercial samples were found to be lower in acidity than the authentic samples.

Based on the histograms the following tentative standards for 'Amchur' have been suggested.

Moisture - 12% (max.), acidity 12% (min.), total ash 6.0% (max.), acid insoluble ash 2.5% (max.), common salt - Nil, Crude fibre 6.0%(max) and total sugars 17.0% (max.).

Studies on sorption isotherms revealed that 'Amchur' was quite hygroscopic and picked up moisture

even at 50% relative hhmidty. The Equilirbium Relative Humidity of mango powder (initial moisture 7.3%) was found to be 46%.

Storage studies on 'Amchur' packed in sealed polythene bags - single and double sperately and also in friction-top-tins and glass jars revealed that 'Amchur' could be kept in the containers for about 6 months at room temperature (12-25°C). During 3 months' storage there was slight to greater darkening in Polythene bags and glass jars. However, after 6 months there was no significant effect. Surprisingly there was slight decrease in acidity during storage.

2.4.6 Development of chutney base for North Indian dietary:

A household survey revealed a general preference of people for chuteny containing fresh corriander and mint leaves besides other spices and also showed their readiness for acceptance of chutney if offered in prepared form. Cheimcal analysis showed that fresh corriander is a good source of ascorbic acid; leaves contained 84.5 mg, flowers 39.7 mg and stem 17.6 mg per 100 g. The loss of ascorbic acid was at R.T. (35-38°C) 67.5% in open and 40.5% in LDPE bags after 36 hours storage. Mint was poor in ascorbic acid containing only 9.0 mg/100 g.The loss in ascorbic acid was 21.6% and 18.4% during blanching and 92% and 86% during drying of coriander leaves conducted without giving any prior treatment and after blanching treatment in ordinary and alkaline water. The drying ratio in sun dried dehydrated corriander was 9.1:1 whereas in mint leaves it was 11.5:1. Blanching treatment adversely affected the flavour of the dehydrated/rehydrated corriander and mint leaves. The chutney prepared from fresh ingredients

was highly acceptable in taste and flavour, the one prepared from dried corrieander and mint was practically devoid of any flavour. However, dried chutney poweder prepared from initally formulated chutney gave a fairly acceptable product on reconstitution. Chutney preserved in bottles with added sodium benzoate or pasteurization remained excellent in taste, aroma and colour over 4 months storage at R.T.

2.4.7 Development of dehulling system for muskmelon, watermelon, and other allied fruit seeds:

Melon seeds are rich source of fat and protein which range from 40-45% and 30-35% respectively. The kernel are commonly used as an adjunct in sweet and snack foods and are recovered from the seeds by manual dehulling which is very laborious process limiting the capacity of dehulling hardly to 100-200 g/man-day. A process for mechanical dehulling has been developed with simple operations using indigenous equipments. The plant and machinery for a 100 kg/hr muskmelon seed dehulling plant is estimated to cost Rs.40,000/-. The cost of dehulling works out to Rs.1/- per kg of seeds. The process has been released to six parties.

2.5 Post-Harvest Technology of Cereals and Pulses:

2.5.1 Investigations on canning of hill maize:

Canned whole kernel and cream style corn is a popular item of food in the European continent and USA. Sweet corn which is used in these products is not grown in India. Attempts to obtain a similar product based on hill maize grown in Himachal gave successful results.

The effect of maturity on quality factors of local solan hill maize was determined on the appearance

of silk and on picking at 20, 23, and 30 days from silking. For this purpose, 500 plants were tagged at the Crop Research Station, Solan. The best quality fraction of floaters in brine having a sp.gr. of 1.096 was reduced from 91.35% at 20 days to 65.2% at 25 days and 9.3% after 30 days. Among the varieties canned, local solan was liked most and next to be preferred was Hybrid HIM-123. The sweet corn Hawaiin sugar variety scored least in organoleptic tests.

2.5.2 Designing and development of storage bins for farmers:

At the request of Government of Punjab, assistance was given in designing an improved grain storage bin (capacity 1.5 tonne) for the use of middle-class farmers and structural details and costs were worked out. About 1000 bins were fabricated at different workshops of Punjab Government and distributed through the Registrar Co-operative Societies to the farmers at the cost price (Rs.150/- bin). These structures proved very popular and created demand for similar bins manufactured and sold by other agencies.

2.5.3 To standardise the receipe, improve the method of preparation and packaging of conventional savoury foods like 'wadian' and 'mukand wadian' of North India.

Physico-chemical compostion: Physico-chemical analysis viz., moisture, total ash, acid insoluble ash, fat, protein, pH, acidity, crude fibre, etc. was carried out for the first time on 51 samples of 'Urad wadian', 20 samples of 'Mung wadian', 33 samples of 'Phul wadian', 8 samples of 'Mukand wadian' and 35 samples of North Indian papads etc. It was observed that urad and mung wadian were good sources of protein (17.1 to 25.3%) and carbohydrates (66.6 to 77.8%). It was also

observed that there was no significant difference in the chemical constituents of these products from different producing centre of Punjab (Amritsar, Jullundur and Ludhiana).

Quality standards: Draft quality standards have been formulated by us for the first time for Urad wadian, 'Mung wadian,' 'Phul wadian' and 'Mukand wadian'. The existing standards (ISI standards) for papads were critically examined for any revision. Based on the first hand data on 35 samples of North Indian papads, it has been observed that the existing ISI standards for papads need revision in respect of the following physico-chemical characteristics; moisture, acid insoluble ash, fat and pH.

Pilot Plant Studies: Pilot plant scale studies on dehydration of black gram (Urad dal) wadian and green gram (Mung dal) wadian were carried out in a cross flow dehydrator and technological data on optimum tray load, number of wadian per tray, effect of size or weitht of wadian on drying characteristics, optimum temperature and time of dehydration, drying ratio, etc. were obtained

Prevention of Mould: For the prevention/control of mould in wadian, various anti-microbial agents namely para-hydroxybenzoic acid, pot. sorbate, pot.propionate, sodium benzoate and KMS were incorporated separately in peethi just before dehydration. Pot.metabisulphite(KMS) was found to be the most effective for the prevention of mould attack in urad and mung wadian.

Fractionation of nitrogen: Systematic studies on the fractionation of nitrogen in 'Urad' (Black gram) dal, 'Mung' (Green gram) dal, Urad wadian, Mung wadian, 'Phul wadian', 'Mukand wadian', whole Bengal gram, roasted Bengal gram, fried green gram dal and Bengal

gram dal were conducted. In Black gram (Urad) dal (raw) Urad wadian and Urad papads, globulin accounted for a major fraction followed by albumin and glutelin. Similar results were obtained in the case of green gram dal, green gram (Mung) wadian.

In salted, spiced and fried 'mung' dal and roasted black gram the major fraction was albumin followed by globulin, glutelin, prolamine and non-protein nitrogen (NPN) in the descending order. In case of phul wadian, albumin accounted for a major fraction followed by glutelin and globulin. In mukand wadian, glutelin accounted for a major fraction followed by globulin, prolamine and then albumin.

Amino acid make up: Amino acid make-up in Urad and mukand wadian was also studied. Results indicate that urad wadian constitute a good source of methionine, lysine, aspartic acid and glutamic acid. Mukand wadian are good source of serine and glutamic acid.

Changes during manufacture: Physico-chemical changes in papads at different stages of their manufacture were studied. Simultaneously, changes in their microbial load were also determined. Studies were carried out on the determination of sorption-isotherm curves for Urad wadian, Mung wadian, Phul wadian, Mukand wadian, papads and other savoury foods like deep-fat-fried and spiced food products, in order to establish their packaging requirements. The ERH of Urad Wadian, Mung wadian, Phul wadian, Mukand wadian and papads were found to be 59.3% 58.6% and 58.4% respectively.

Storage studies: Storage studies at room temperature were also carried out on the above mentioned savoury foods after packing them in friction-top-tins, in low density polyethylene bags of 100,200, 300 and

400 gauge. In short, LDP bags (200 gauge and above) were found suitable for storage. Friction-top-tin was found to be excellent for storage of all types of savoury foods studied. After six months' storage, fried dal became slightly rancid in 100 and 200 gauge LDP poly bags. In LDP bags of 300 gauge and above, the development of rancidity was low and hance were found suitable for packing and storage. Microbial load (yeast and mould counts) on these savoury foods were determined, which varied considerably.

2.5.4 Studies on the use of processed maize in the North Indian dietary pattern:

Coarse grains like maize and other millets find only a very limited use in North Indian dietary pattern. The production of maize has declined in Punjab from 8.46 lakhs tonnes in 1975-76 to 6.13 lakhs tonnes in 1980-81 possibly due to its poor off-take and inadequate utilisation which at present is mostly limited to preparation of maize roti only. Trials were conducted to promote enhanced utilisation of maize in North Indian dietary.

Dehusked and degermed maize flour (processed maize flour) was prepared in mini maize mill developed at CFTRI, Mysore. Recovery of dehusked and degermed maize grits was less in white maize (73%) as compared to 83% in yellow maize. Analysis of four specific varieties of maize viz., Pratap J-54, Vijai Ropar, Agethi-76 and Local procured from Punjab Agricultural University, Ludhiana showed that moisture content ranged from 6.38 to 7.13%, either extract from 5.66 to 6.20% and protein (N x 5.7) from 10.5 to 11.0%.

Incorporation of maize flour was tried in different proporations in some of the popular sweet and savoury products of North India, as a partial replacemen-

of traditionally used raw materials and the prepared products thereof were subjected to acceptability studies. In the products made from 'Besan' (Bengal gram flour), the yellow maize flour could be incorporated to the extent of 30% in sewian, 20% in mathi and matter without materially changing the physicochemical and organoleptic characteristics of the products made from traditional raw materials only. But at higher levels of incorporation the products gave a distinctly perceptible maize flavour and hence not acceptable as conventional products.

Equilibrium Relative Humidty (ERH) and storage/ shelf life studies were carried out on flours of Bengal gram, maize and their mixture as well as on products like sewian and boondi made from traditional raw materials and in combination with maize flour. For sevian the ERH was 24.4% for control and 22.5% for treated sample. The critical moisture content for treated and control sewian was 8.7% and 9.5% and both lost texture at 70% RH and showed mould growth at 90% RH on the 4th day. For boondi the ERH for control and treated samples was 19.5% and 20.7% respectively. The products remained perfectly well upto 60% RH but at 80% RH became unacceptable within one day due to loss of texture. Mould appeared on the 7th day at 90% RH. The danger point was reached at 62% RH while the critical point was at 65% RH. In the case of flours of Bengal gram, maize and their dry-mix the ERH was 71%, 46.5% and 54% respectively. All the flours remained good upto 70% RH but caking started at 80% RH, and mould growth was noticed on the 7th day in all the cases at 90% RH. The danger point was at 75% and the critical point was at 80% RH for all the samples.

Storage studies of the products and the raw materials were carried out in three types of containers viz., friction-top-tins, screw cap glass jars and low density polythene bags. On the whole, friction-top-tins were found better containers. Free fatty acid content was a good index of development of rancidity in the stored samples.

The problem of dough breakage often confronted in the preparation of maize roti from commercially available maize flour was investigated. The granularity of market samples of maize flour was ascertained. Atta with larger fractions of particle size of more than 450 micron mostly led to this problem. Use of hot water in making the dough helped to solve the problem in some cases. The problem was completely overcome when processed maize atta was used. Incorporation of atta at 10-20% level in wheat chapati helped overcome the dryness and chewiness in wheat chapati usually noticed during short storage of the chapathis.

3.0 R & D work - On Going:

3.1 Study of rice production and processing system in Punjab and Haryana - Its Problems and Solutions:

A survey proforma was fomulated to collect information on the status of rice milling industry and its problems. The proforma was mailed to nearly 150 rice mills in Punjab but there was practically no response. Consequently the rice mills in some selected locations were visited personally and necessary information collected. The information was also collected on the production of paddy in Punjab and the number of existing rice mills. An analysis was

made on the scope of setting up of additional rice mills, which showed that Punjab had already built up surplus milling capacity. Paddy samples were collected from the fields at harvesting/threshing stage, mandies and from the mills and analysed for moisture contents and other refractions. Samples of paddy collected from the feeding point for milling and the composite sample of rice obtained after milling without separation of any kind of brokens were analysed for moisture contents and brokens to bring out any relationship between the moisture content of paddy at the time of milling and the proportion of broken rice obtained thereof under commercial conditions of milling.

Preliminary experiments on high temperature drying-cum - parboiling of paddy were conducted using an experimental fluid bed unit at air temperature from 110-180°C for 1-6 minutes which showed mild parboiling.

3.2 Studies on production pattern and processing methodologies of common pulses in Punjab, Haryana & U.P. etc. to identify main difficulties and initiate suitable remedial measures.

In order to identify the problems of this industry, literature survey on processing aspects of dhal was carried out. A list of addresses of about 100 dhal mills of Punjab, Haryana and Rajasthan was prepared in order to collect information from them. Enquiries alongwith proforma on survey of pulse processing industry were issued to more than 70 dhal mills in these three states but no response was recieved. subsequently about 25 dhal mills in Punjab and Haryana were visited to collect data on the manufacturing process, machinery, problems encountered by the millers, etc. During our survey it was observed that millers

are very reluctant to change their traditional methods due to financial reasons and they are hardly quality conscience. Some dhal millers showed keen interest in adopting CFTRI technology provided the same was demonstrated to them and incentives were avialable. Dhal mills are shifting to Delhi from Haryana due to additional taxes in Haryana.

3.3. Techno-economic survey of I-ndian traditional foods:

A careful study and assessment of technological status of traditional food industry will provide a good base for identifying traditional foods which need either development of new technology or improvement on the existing technology to increase productivity through diversification of raw material, development of equipment and suitable packages. This could help building the industry which already has potential in domestic and external markets. It is essential to identify the regional traditional foods and their socio-economic relevance and to gain insight into the commercial sector and study their scale of operation, technology adopted, equipment used, mode of package and shelf life of the product prepared.

Collected possible addresses of manufacturers of traditional food products like papad, wadian, pickles, confectionery, sweets and bakery and sent to Mysore for compilation. Enquiries to 200 numbers were sent to Health Officer, Sales Tax Officers and General Mangers of District Industry Centres of Punjab, Haryana, Himachal Pradesh, Rajasthan and Jammu & Kashmir states in this regard.

Collected data on manufacture, sales and other aspects of traditional sweet manufacturers, 'karyana'

stores selling these food products. Also collected and compiled the data on the traditional foods prepared and consumed at household level from the people of different income groups in the form of questionnaire.

3.4 Stabilisation of vegetables by fermentation as a low energy process for better utilisation of raw materials.

Fresh vegetables e.g. cauliflower, carrot, okra and bettergourd were subjected to fermentation in 2% brine using Lactobacillus Plantarum culture, with the motive to extend the shelf life and subsequent direct use in reprocessing. In the preliminary trials conducted, the cauliflower and carrots showed a shelf life of 2-3 months. Curried vegetables were prepared from these fermented vegetables and found satisfactory in respect to colour texture and mouthfeel, but lacked in characteristic aroma/flavour of the vegetables. Likewise okra and bittergourd were examined to extend their shelf life. Okra pods showed a storage life of 3 months at room temperature (30-42°). However, bittergourd was hardly preserved over a month. Less of chlorophyll during storage is prominent. Further work in this regard is in progress.

Chips from stored potatoes with high sugar content were subjected to fermentation by Lactobacillus plantarum culture in 2% brine in order to obtain good coloured (golden to white) fried potato chips. The results in this regard are encouraging and further work is in progress.

3.5 Utilisation of tomato seed in the manufacture of bread, biscuit, vermicellies and other paste products like 'wadian' and papads etc.

For utilization of tomato pomace which is a growing industrial waste, physico-chemical characteristics of tomato seed powder were studied in respect of

moisture, total ash, fat, protein crude fibre, lycopene and sugars etc. Physico-chemical characteristics of seed oil and fraction of protein of tomato seeds into albumin, globulin, prolamin and glutalin was also carried out. The utilization of seed powder in the preparation of deep fat fried and salted sewian and mathi has been tried and organoleptic evaluation in respect of colour, texture, taste and flavour and overall acceptability has been done. Further work is in progress.

3.6 Improvements and mechanisation of the Traditional Processing of Saffron in J&K

Saffron is one of the highly priced spices worth about Rs.12,000/- per kg. It is made of the dried stigmas of the flowers of Crocus, sativas Linn. Cultivation of saffron in India is mainly confined to the state of J&K with about 5000 hectares under the crop and with annual estimated production around 15 tonnes.

To make on the spot study of the problems faced by saffron growers and processors, saffron farms were visited alongwith officials of Directorate of Agriculture, J&K. Also visited saffron processing centre at Pampore and discussed the current method of saffron processing. It was observed that there is no control on different processing steps like separation of stigmas from other floral parts, drying, grading etc. The quality of dried saffron is considered inferior compared to Spanish saffron. There is scope to mechanise the process of sorting, drying grading etc. to get a quality product. Directorate of Agriculture J&K showed keen interest in the work and agreed to collaborate.

4.0 PROPOSED R&D WORK;

4.1 Studies on the preparation, packaging and storage of some traditional cereal/legume based sweets like 'laddu', 'pinni, ' besan laddu' and 'balushahi' etc.

4.2 Studies on development of indigenous food flavours.

4.3 Studies on improvement of the nutritional quality of Bajra by microbial fermentation and development of traditional 'Bajra' food products.

4.4. Studies on the suitability of North Indian fruits for manufacture of processed products like R.T.S. beverage, fruit bars, cerealed flakes etc.

4.5 Studies on in-package fumigation of temperate fruits to extend their post-harvest storage life.

4.6 Studies on development of temperate fruit products

5.0 TECHNICAL ENQUIRIES|CONSULTANCY TO ENTREPRENEURS:

Over 1,000 enquiries received form the processing industry, entrepreneurs and general public were attended over the span of last 15 years regarding starting of new food based industries in the region, improvement of the existing ones and on the various process developed by CFTRI, Mysore.

6.00 TECHNICAL ASSISTANCE RENDERED:

Consultancies had been provided to several parties from this station, some of them are listed below:

6.1 Markfed Canneries, Jullundur:

i) Process worked out at the station for canning 'sarson-ka-saag' in curried form.

ii) A common acceptable recipe for 'sarson-ka-saag' in curried form. The cannery is presently processing over 50,000 cans yearly both for the internal market and export trade based on the know-how provided by this station.

iii) Method for canning 'bhindi' for export purposes.

6.2 National Fruit Products, Ludhiana

i) Layout plan for the expansion of the unit, details of machinery required and operational details for pickles and preserves, etc.

ii) Know-how in respect of fruit based beverage and canned products

6.3 Giani Di Hatti, Chaura Bazar, Ludhiana.

i) Improvements in the manufacture and storage of some traditional food items such as 'papad' and 'wadian'.

ii) Live demonstra tion of papad, wadian manufacturing process.

6.4 Grape growers Association of Punjab, Ludhiana:

i) Inpackage fumigation of grape bunches packed in baskets for transportation to cut down wastage and extend shelf-life.

ii) Process for the manufacture of grape drink and raisins.

6.5 MARKFED Oil and Vanaspati, Industry, Khanna:

i) Prevention of aflatoxin development in groundnut and groundnut cake.

ii) Continuous groundnut drier, its performance defects and scope for further improvement.

6.6 Small Industries service Institute, Ludhiana.

Lectures in respect of food industry in general, scope for starting new food industries in Punjab and manufacture of food machinery in Punjab delivered to the unemployed graduate apprentices undergoing training at the S.I.S.I., Ludhiana.

6.7 M/s Kitch-Comfs Pvt.Ltd, Chandigarh:

Commissioning of fruits and vegetables factory at Morinda, Punjab.

6.8 M/s Sarabjit Dhanda, 29, Green Park, Ludhiana:

Utilization of egg yolk for bakery and other purposes, and improving the efficiency of their machinery making albumen flakes.

6.9 M/s Goverdhan Udhyog, Mayapuri, New Delhi:

Papad, noodles and vermicelli preparation.

6.10 M/s Punjab Agro Industries Corporation, Chandigarh:

Tomato puree and malta juice concentrating plant at Abohar.

6.11 M/s Haryana Agro Industries Corporation Chandigarh:

Setting up the fruit juice plant at Murthal, Haryana.

612. M/s. Director of Horticulture, Punjab Govt. Patiala:

Preservation of vegetables by steeping and ketchup manufacture.

6.13 M/s. Chaudhary & Sons, Srinagar:
Improving their apple juice

6.14 M/s. J&K Agro Industries Corporation Srinagar:
To improve the quality of dehydrated apricots.

6.15 Department of Agriculture, J&K Govt. Srinagar:
Regarding walnut dehydration and saffron dehydration.

6.16 MARKFED Modern Rice Mills, Rajpura, Punjab:

Installation of rice bran stabilization.

6.17 Punjab Financial Corporation, Chandigarh:

Technical appraisal on various project proposals submitted by entrepreneurs for setting up food industry in Punjab.

7.0 ANALYSIS/TESTING:

a) Chemical analysis of tomato ketchup	- WIMCO Limited, Chandigarh
b) Physico-chemical analysis of malta oranges	Punjab Agro Industries Development Corpn. Chandigarh.
c) Analysis of Mango pulp	- State Trading Corph.Delhi
d) Physico-chemical characteristics of amla & carrot preserves	National Fruit Products Ludhiana
e) Analysis of KMS	- Assistant Director of Hort., Patiala, Punjab.
f) Preserve samples from M/s Kesarmal Sitaram Sachdev-	Nawan Shahar, Doaba, Jullundur.
g) Ghee Slush Analysis	- M/s Chemanlal Agarwal, Pratap Chowk, Moga.
h) Analysis of Rice husk for moisture	- M/s R.Gupta & Co.Ludh.
i) Analysis of water samples, pH, acidity & alkalinity	- Hindustan Auto Tubes, G.T.Road, LUDHIANA
j) Analysis of canned mango pulp	- M/s. Markfed Canneries, Jullundur

Amount collected towards analysis/testing has been Rs. one thousand approximately.

8.0 SURVEYS:

Surveys on various agro-based commodieties were undertaken to consolidate the up-to-date data on availability of raw materials etc in order to explore the potentialities of their industrial exploitation. The information regarding present position of food industries in the sates and its prospects for development have been included in these surveys.

a) Cool storage of apples of Kashmir at place of production - present position and future prospects.

b) Agro-horticultural survey of raw material of Himachal Pradesh and their utilization.

c) Agro-horticultural survey of raw materials of Jammu & Kashmir and their utilization.

d) Agro-horticultural survey of raw materials of Haryana and their utilization

e) Food Industries in Haryana - Present status and future prospects.

f) Modernisation and mechanisation of 'wadian' and 'papad' industry in Punjab.

g) Production and marketable surplus of agriculture raw materials of Punjab and problems associated with their effective utilisation.

h) In plant survey of M/s Choudhary Product Co., Srinagar at the instance of SISI Srinagar under Central Govt. Scheme of modernization of small units in Fruits & Vegetables Preservation.

i) Consumers acceptance survey on cashew apple beverages

j) Pickle industry in Punjab Region.

k) Chutney prepared in Punjabihomes.

l) Storage of rice in mandies and some villages.

m) Malta orange industry in Punjab.

9.0 FEASIBILITY/SPECIAL REPORTS PREPARED FOR:

a) M/s Kitch-Comfs (P)Ltd, Chandigarh - for setting up a fruits and vegetables processing factory at Morinda, Punjab.

b) Directorate of Horticulture, Srinagar, J&K Govt. - for dehydration of apricots.

c) Master plan for the expansion of R&D activities at Experiment Station, Ludhiana.

d) Details of report on Egg yolk utilization to M/s Sarabjit Dhanda, 29, Green Park, Ludhiana

e) Details of report on noodles, vermicelli manufacture to M/s. Goverdhan Udhog, New Delhi.

f) Food Industry in Haryana - Present status and future prospects for Technical Expert, Directorate of Industries, Haryana.

g) Prepared non-technical notes on various processes/ products developed at Expt. Station, Ludhiana.

10.0 LECTURES AND DEMONSTRATIONS:

	Institution for which training given	Location	Subject
a)	*Small Industries service Institute	Ludhiana	Some New Developments in the Area of Food Science & Technology.
b)	*Block Development & Panchyat Officer	Moga, Punjab	Canning of fruits and vegetables
c)	*Punjab Agricultural University	Ludhiana	Purees, sauces & Curries Vegetables
d)	MARKFED Canneries	Jullundur	Quality Control Measures in the Commercial Production of Sarson-ka-saag.
e)	*Haryana Agro-Food & Fruits Processing Factory	Marthul Haryana	Quality Control Measures for Correct Determination of Soluble Solid in Hot Fruit pulp Products.
f)	Vashist Rice Mills	Khanna, Punjab	Parboiling of Paddy
g)	*Indian GrainStorage Institute	Ludhiana	Mycotoxinsin Food & Quality Control in Food Grain and their Products
h)	*Punjab Agri.University Regional Station	Abohar	Utilization of Kinnow Orange & Future Scope.
i)	*AFST Chapter	Ludhiana	Modernisation and Mechanisation of Traditional Savour Foods.

j) Local Entrepreneurs and three institutions	Ludhiana	Preservative Treatment of Wadian for an Industry from Ludhiana & preparation of Jam from cold stored apples.
k) An Industry from Ludhiana	Ludhiana	Preservation Treatment for Wadian
l) *Deptt. of Resettlement of Defence Officers	Amritsar	Scope for Food Industry in Northern Region.
m) *Instt. of Engineers, College of Agri., Engg., PAU	Ludhiana	Recent Advances in Food Technology
n) *Indian Grain Storage Instt. Deptt. of Food	Ludhiana	Mycotoxins in Food & Feeds their Detection, Estimation & Curative Measures.
o) *Oil Technologists Association, Punjab Branch	Ludhiana	Advances in the detection of Adulteration in in vegetable oils and Fats
P) Kisan Mela	Ludhiana	Waxing of Apples
q) Giani Di Hatti - a local Industry	Ludhiana	Prevention of Mould in Wadian.
r) Sri Sood	Ludhiana	Dehydration of Chillies
s) Managing Director Horticulture Processing Marketing Division Govt. of J&K	SRINAGAR	Walnut Processing Machinery
t) Gulam Mohamed, Shopian, J & K	LUDHIANA	Washing of Walnuts
u) Chairman and Member of Coordination Group	Ludhiana	Waxing of apples
v) Instt. of Engineers, Ludhiana Chapter & AFST, Ludhiana Chapter	Ludhiana	Recent advances in Spice Tech.
w) Mr. S.P.Sood & Party Iqbal Ganj	Ludhiana	Dehydration of Chillies.

x) Gianiji Di Hatti	Ludhiana	Dehydration of Wadi and Papads.
y) Himachal Ginger, Renuka Dist. Sirmur, HP	Ludhiana	Dehydration of Ginger & manufacture of Ginger oil & Oleoresin.
z) Grape Growers Association Punjab	Ludhiana	Practical Demonstration of Grape Transportation Tech In-Package Fumigat
aa) Grape Grower	Bhatinda, Punjab	In-package Fumigation of Grapes
bb) Rural Infestation Control	Ludhiana Moga, Jagroan, Khanna	Storage of Food Grains in Bins and Bags.
cc) In-charge, Fruit Preservation Factories, Govt. of Punjab.	Ludhiana	Demonstration of a simple Technique for steeping Preservation of Fresh Vegetables
dd) Directorate of Horticulture J&K Govt.	SRINAGAR	Dehydration of Apricots

11.0 SUPPLY OF PRODUCTS, BLUE PRINTS AND DRAWINGS:

a) Blue prints were supplied to M/s Jaswinder Mechanical Works, Taran Taran(Punjab) for our mini rice mill.

b) Samples/products made from fresh peach, pear and plums to Deptt. of Horticulture, PAU, Ludhiana

c) Scheme for starting a fruit preservation factory to statistical officer, Ludhiana

d) Supply of sulphur house design and sulphur box to Sh. Mallick, Directorate of Horticulture, Srinagar, J&K Govt.

12.0 PROCESSES RELEASED TO THE INDUSTRY :

12.1 A process on Mechanical Dehulling of Muskmelon seeds released to the following parties:-

a) M/s Dinesh Trading Corpn. Sitaram Bazar, Kesarganj, AJMER-305 001 (Rajasthan).

b) Lt.Col.Madhava Shyam, C-96, Defence Colony, MEERUT - 250 403

c) Mr. Rewal Singh, 74, Garden Colony, Model Town, Jullundur

d) M/s Deepak Woolen Mills, G.T.R oad, Panipat.

e) Shri Sitaram Sharma, C/o. Sri Sitaram Nareshwar, 9-C, Fetehpuri, Delhi-110 006

12.2 Process submitted:

A process on Improvements of potato waffers Quality.

13.0 PUBLICATIONS :

13.1 Research Papers published:

a) Physico-chemical changes during development of safeda guava fruits.
Rodriguez., R., Agarwal, P.C., and Saha N.K.
Indian Good Packer, 1971, 25(1)5.

b) Effect of maturity of safeda guavas on flavour preferences. Rodriguez., R.Agarwal P.C. and Saha N.K. Indian Food Packer 1971,25 (1),13.

c) Physico-chemical characteristics of apricot varieties of Kumaon region and their suitability for canning.
Rodriguez., R.Agrwal, P.C. and Saha N.K.
Indian Food Packer, 1971, 25 (2),5.

d) Utilization of mango peel as a source of pectin. Beerh, O.P., Raghuramaiah, B., and Krishnamurthy, G.V.
J.Fd.Sci. & Tech. 1976, 13(2),96

e) Effect of pre and post-harvest treatments to control some disorders in 'Anab-e-Shahi' grapes.
Beerh, O.P. Krishnamurthy, G.V., Narasimham P., Girdhar N and Raghuramaiah B.
Jr.Fd.Sci. & Tech. 1976,13 (3), 129

f) Utilization of mango waste: recovery of juice from waste pulps peel.
Beerh, O.P., Raghuramaiah, B and Krishnamurthy, G.V. & Giridhar, N.
J.Fd.Sci.Tech. 1976, 13(3) 138

g) Physico-chemical characteristics and canning trials of some varieties of tomatoes grown in Central India
Beerh, O.P., and Rane, V.R. J.Fd.Sci. & Tech. 1976,13 (3).142

h) Studies on dehydration of tropical paddy mushroom (Vol.Volvacea)
Pruthi, J.S., Gopalkrishnan, M. and Bhatt, A.V. Indian Food Packer, 1978, 32(2),7

i) Quality, packaging and storage requirements of dehydrated foods.
Pruthi, J.S. Indian Food Packer, 1978, 32 (2),30.

j) Processing technology for kinnow, mandarins.
Pruthi, J.S. Punjab Hort. J. 1978, 18 (3&4),199

k) Nitrogenous substances in some traditional savoury foods.
Pruthi, J.S., Raina, B.L., Manan, J.K., and Kalra, C.L. Proceedings National symp. Protein Foods, Loyala College, Madras, 1979.

l) Studies on the evaluation of pea varieties for processing.
Rodriguez, R., Raina, B.L., Kalra, C.L. Varadarajan, A.R., Teotia, M.S., Nandpuri, K.S., Kumar, J.C. and Dhillon, G.S.
Indian Food Packer, 1979, 33 (6),38-51.

m) Role of fresh and processed fruits in human nutrition.
Pruthi, J.S. J.Beverage Fd.Wld.1979, 6 (A).

n) Nutritive value, post-harvest technology and processing technology of cashewnut.
Pruthi, J.S. J.Beverage Fd.Wld. 1979,6(3),23.

o) Spice Essential Oils - their use in perfumery Cosmetic.
Pruthi, J.S. PAFAI J. 1980, 2 (2),27.

p) Studies on technological assessment of quality of ginger grown in Himachal Pradesh.
Raina, B.L., Teotia, M.S., and Pruthi, J.S. Indian Cocoa, Arecanut and Spices J.1980,4 (2),32-35.

q) Studies on varietal suitability of tomatoes for ketchup manufacture.
Pruthi, J.S., Saxena, A.K., and Teotia, M.S. Indian Food Packer, 1980, 34(2), 22-28. (22-30)

r) Cherries-I, Agri-Horticultural and chemical aspects (Review).
Pruthi, J.S., Saxena, A.K., and Teotia, M.S. Indian Food Packer, 1980, 34(5),33-58.

s) Studies on the determination of optimum condi-tions of preservation of fresh vegetables in acidified sulphited brine for subsequent use in Indian style curries.
Pruthi, J.S., Saxena, A.K. and Manan, J.K. Indian Food Packer 1980, 34(6).9-16.

t) Studies on suitability of some tomato varieties for canning.
Raina, B.L., Kalra, C.L., Teotia, M.S., Rodriguez,R., Nandpuri, K.S., Kanwar, J.S. and Singh S. J. Veg.Sci. 1980, II (1),60-66.

u) Physico-chemical characteristics and formulation of quality standards for some traditional savoury foods (Part-I), Urad Wadian and Mung wadian.
Pruthi, J.S., Manan, J.K., Kalra C.L., and Raina, B.L., ISI Bull. 1981, 33(4),53

v) Physico-chemical characteristics and formulation of quality standards for some traditional savoryfoods.
Pruthi, J.S., Kalra, C.L. Manan, J.K., and Raina, B.L. ISI Bull. 1981, 33 (4),53.

w) Studies on the canning of curried mustard greens 'sarson-ka-saag' (Brassica cambestries, Var.Sarson).
Raina, B.L., Kalra, C.L., Rodriguez, R., Teotia, M.S., Varadarajan, A.R. and Dhanaraj, S. Indian Food Packer, 1982, 36 (1) 91-95.

x) Studies on the influence of variety on the quality of processed cauliflower.
Raina, B.L., Pruthi, J.S., Kalra, C.L., Teotia, M.S. Indian Food Packer, 1982, 36 (2),7-15.

y) Studies on the influence of variety on the quality of processed okra (Hibiscus esculatus L.)
Kalra, C.L., Pruthi, J.S., Teotia, M.S., Raina, B.L., Sharma, B.R. and Nandpuri, K.S. Indian Food Packer 1982, 36(2),53-62.

z) Detection of adulteration of tomato ketchup by histological characteristics and staining techniques.
Beerh, O.P. Indian Food Packer 1982, 36 (2),28-34.

aa) Studies on the manufacturing, packaging and storage of North Indian Spiced papads.
Pruthi, J.S., Kalra, C.L., Manan, J.K., and Raina, B.L.,
Indian Food Packer, 1982, 36(3), 43-49.

bb) Cherries-Part II. Technological Aspects.
Pruthi, J.S., Saxena, A.K., and Teotia, M.S. Indian Food Packer, 1983; 37(3), 77.

cc) Custard apple (Annona Squamosa) Part I Physico-morphological characters and chemical composition.
Beerh, O.P., Giridhar, N. and Raghuramiah, B.
Indian Food Packer, 1983, 37(3),77.

dd) Studies on the influence of variety on the quality of processed bittergourd.
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ee) Influence of pre-treatment on the quality of canned okra.
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hh) Canning of orange segments.
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ii) Studies on the influence of variety on the quality of dehydrated okra.
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jj) Chemistry and Technology of okra - A resume.
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kk) Studies on improvement in whiteness and extension of shelf-life of fresh and processed mushrooms.
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ll) Utilisation of kinnow and Malta oranges.
Pruthi, J.S., Manan, J.K., Teotia, M.S., Setty, G.R., Eipson, W .E., Saroja, and Chickkapajee, K.C. 1984.
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mm) Studies on the improvement of the traditional method of manufacture of carrot murrabba.
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13.2 Books Published:

a) Spices and Condiments - by J.S.Pruthi, National Book Trust of India (For Arogya) 1979.

b) Spices & Condiments - Chemistry, Microbiology and Technology by
J.S.Pruthi. Advanves in Food Research, Supplement 4, Academic Press, N.Y.1980

c) Chapter in a book on Post-harvest Technology of tropical fruits by R.Rodriguez & B.L. Raina, 1975.

13.3 PAPERS IN PRESS:

a) Sorption behaviour of melon seed kernels.
Teotia, M.S. J.Fd.Sci.Tech.

b) Packaging and storage studies on flour of Bengal gram, maize and their dry-mix.
Teotia, M.S., Saxena, A.K., and Beerh, O.P.
Indian Food Packer.

c) Studies on Food uses of maize: preparation, packaging, and storage of deep fat fried salted 'boondi'.
Saxena, A.K., Teotia, M.S. and Beerh, O.P.
Indian Food Packer.

d) Studies on Food uses of maize: Preparation, packaging and storage of deep fat fried salted sewian.
Beerh, O.P., Saxena, A.K., and Teotia, M.S.
Indian Food Packer.

e) Studies on the physico-chemical composition, packaging, storage and formulation of quality standards for Anardana (dried pomegranate seeds).
Pruthi, J.S. and Saxena, J.K. J.Fd.Sci.Tech.

f) Variability in physico-chemical characteristics of spiced papad of Punjab.
Pruthi, J.S., Manan, J.K., Kalra, C.L. and Raina, B.L. J.Fd.Sci.Tech.

g) Melon seeds - Evaluation of physical characteristics.
Ramakrishna, P. Indian Research & Industry.

h) Harvesting, storage, chemical composition and processing of cauliflower (Brassica oleracea var.botrytia).
Indian Fd. Packer.

i) Food Industry in Haryana - present status and future prospects.
Ramakrishna, P., Manan, J.K. and Potty, V.H. Udyog Yug.

j) Chemistry and Technology of Melon seeds.
Teotia, M.S . and Ramakrishna P. J.Fd.Sci. and Tech.

k) Studies on the evaluation of onion varieties for their suitability for dehydration.
Raina, B.L., Teotia, M.S., Pruthi, J.S., Kalra, C.L., Jarnail Singh and Nandpuri, K.S. Indian Food Packer.

l) Physico-chemical composition and formulation of quality standards for amchur (dehydrated mango powder).
Pruthi, J.S. and Teotia, M.S. J.Ind.Cocoa. Arecanut & spices.

m) Melon seeds - A nutritious food adjunct.
Teotia, M.S. and Ramakrishna P. Research & Industry.

14.0 PAPERS PRESENTED AT SYMPOSIA, CONFERENCES AND SEMINARS:

a) Amla, B.L. Bird's eye view of food Industry. presented at Symposium on Scope of Food Industry in Punjab, PAU, Ludhiana December 1972

b) Pruthi, J.S. Quality Control, Packaging and Storage Requirements of dehydrated foods, Presented at Symposium on Dehydrated Food Industry in India, New Delhi, 10-11 Dec.77.

c) Pruthi, J.S. Role of CFTRI in International Cooperation in Technical Education in Food Science and Technology for developing countries. Presented at the 8th National Convention of Indian Society for Technical Education, Patiala, 22-23 December 1978.

d) Pruthi, J.S., Saxena, A.K. and Teotia, M.S. Chemistry and Technology of Cherries, Part-I-Agro-horticultural and Chemical Aspects.

e) Pruthi, J.S . Development of Modern Rice Milling Technology and related R&D work done at CFTRI. Presented at the seminar, 'Post-modernisation problems in Rice Milling, PAU, Ludhiana, 13-14 October 1979.

f) Pruthi, J.S. Spice Essential Oils - their production, packaging and utilization. International symp. on Essential Oils, Bangalore Oct-November 1979.

g) Pruthi, J.S. Nutritive value, Post-harvest technology and processing technology of cashew apple. First International Symposium on Cashew, Cochin, 12-15th March 1979

h) Pruthi, J.S., Raina, B.L. Manan, J.K. and Kalra, C.L. Nitrogenous substances in some Traditional Savoury Foods. Presented on Protein Foods, Madras 17-19th March 1979.

i) Pruthi, J.S. Key note address: Importance of quality Control and Standardisation of oil and fats. Mini Workshop on processing of edible oils, Punjab Agri. Univ., Ludhiana, 2nd December 1980.

j) Pruthi, J.S. Utilisation of Agricultural Waste. Presented at the National Symposium on 'Utilization of Agricultural and Forest Residues'. Pb. Univ. Dept. of Chem. Engg. Chandigarh, Sept. 26-28, 1980.

k) Pruthi, J.S., Raina, B.B., Kalra, C.L., Teotia, M.S. Technological Assessment of new varieties of okra, bittergourd, White onions and cauliflower for processing. Annual Convention/ Technical Advisory Committee Meeting of AIFPA, New Delhi, 21st November 1980.

l) Pruthi, J.S. Quality Control, Packaging and Storage of Turmeric. Invited Lead Paper. Ibid.

m) Pruthi, J.S. Quality Control, Packaging and Storage of Ginger, Invited status paper presented at the 'National Seminar on Ginger & Turmeric', 8-10th April 1980, Calicut(Kerala)

n) Pruthi, J.S. Development of Modern Rice Milling Technology and a resume on R&D work done at CFTRI. Presented a t the Workshop on 'Rice Milling, Oct.80 PAU, Ludhiana.

o) Pruthi, J.S . Bhat, A.V., Sathyavathi Krishnan Kutty, and Gopalakrishnan, M. Studies on Chemical Composition and Development of edible By-products from Nutemeg waste. Presented at the Symposium by Products 2nd Annual Convention of Food Scientists and Technologists, AFST Mysore, 29-30th May 1980.

p) Pruthi, J.S., Sathyavathi Krishnan Kutty, and Krishnan Kutty. A Study of factors governing recovery and quality of pectin from nutmeg waste (Rind). Presented at the Symp., "By-products from Food Industries Utilisation and disposals". 2nd Annual Convention of Food Scientists and Technologists, Mysore, 29-30th May 1980.

q) Pruthi, J.S., Manan, J.K., Kalra, C.L. and Raina, B.L. Studies on the manufacture, Packaging and storage of traditional savoury food (wadian) of India. Presented at International Symposium on Recent Advances in Food Science and Technology, Teipeh, 9-11 Jan. 1980.

r) Pruthi, J.S. Post-harvest technology and and processing technology of green pepper. (P.nigrum L.) Presented at International Workshop on pepper processing and pepper products, Mysore 23-24 May 1981.

s) Pruthi, J.S., Mannan, J.K., and Teotia, M.S. Beverage development from kinnow and malta

oranges. Presented at symposium on problems and prospects of food fermentation and beverage industry. AFST Bangalore, 1981.

t) Pruthi, J.S. 'Manufacture and use of spice Essential Oils'. Paper presented at the PAFAI Seminar at New Delhi, 23-24th January 1981.

u) Beerh, O.P. Role of CF TRI for development of Agro-industry. Presented at seminar on scope of Food Industries in Haryana at Kurukeshetra in June 17-18, 1982.

15. BOOK REVIEW:

Pruthi, J.S. - Potatoes, Production, Storing and Processing, Ora Smith Avi Pub, Co. In., West Port, Connectient, USA (for Indian Food Packer)

16.0 HONOURS, AWARDS, DEGREES

16.1 Raina, B.L. PAU, Ludhiana, 1983, Ph.D (Food Science)

16.2 Pruthi, J.S.

1)	Indian Standard Instt.New Delhi	ISI Fellowship
2)	PAFAI, Bombay	Fellowship
3)	All Indian Food Preservatives Assen.New Delhi	K.U. Patel Memorial Award for the best article in Indian Food Packer
4)	-do-	-do-
5)	-do-	Cooper Memorial Medal for best article

6) National Independence Day award(NRD C): for the patent based on the development of a simple and novel process for canning of tender green pepper.

17.0 MEMBERSHIP OF COMMITTEES:

17.1 Dr.S.K.Berry:

a) Advisory Committee of Punjab Financial Corpn. Chandigarh

b) R&D and Design Committee for Punjab, Himachal Pradesh and Union territory of Chandigarh.

17.2 Mr. O.P.Beerh

a) Advisory Committee of Punjab Financial Corpn. Chandigarh

b) R&D Committee for Punjab, Himachal Pradesh Union Territory of Chandigarh.

17.3 Dr.J.S.Pruthi

a) R&D and Design Committee for Punjab, Himachal Pradesh, and Union Territory of Chandigarh.

b) ISI Sub Committee PCDC 18:1 Methodologyof tested for Essential oil.

c) Advisory Committee of Punjab Financial Corpn. Chandigarh

17.4 Mr.K.K.Mookerji

a) R&D Committee for Punjab, Himachal Pradesh and Union Territory of Chandigarh.

18.0 TRAINING/APPRENTISHIP/EXHIBITION :

a) Organised a short term course on Fruit & Vegetable Preservation on domestic scale for JBT Students at Training College, Simla.

b) Provided trining to post-graduate, diploma course trainees in laboratory techniques and quality control.

c) Participated Asia '72, New Delhi

d) Participated Indian International Trade Fair'79, New Delhi.

e) Arranged exhibition at Kisan Mela at Punjab Agri. University Ludhiana

19.0 SEMINAR, SYMPOSIA ORGANISED :

19.1 a) Organised a seminar on scope for Food Industries in Punjab in collaboration with the Punjab Agri. University, S.I.S.I. and the Directorate of Industries, Punjab. Numerous papers were presented during siminar relating to the present position in respect of food industries and scope for expansion. The station also put up an exhibition relating to CFTRI processes which have an application in the region.

19.2 b) Workshop on Bakery Industries held at Punjab Agri. University Ludhiana organised in collaboration with Punjab Agri. University. AFST (Ludhiana Chapter),SISI, Wheat Assoc. and Socity of Indian Bakers, 17-18 December 1982.

20.0 TECHNICAL COLLABORATION WITH OTHER ORGANISATIONS:

a) Deptt. of Vegetable Crops, Punjab Agri. Univt.Ludhiana Pb	a) Screening of new varieties of fruits and vegetables. b) Screening of new varieties of bittergourd and okra. c) Screening of differentvarieties of toma-to cauliflower, onion, garlic etc. d) Studies on maintenance of whiteness of mushrooms by steeping. e) Assessment of peaches, pears and plums for suitability for processing.
b) Depa-rtment of Horticulture Srinaga r, J&K	a) Post-harvest technology of minor temperate fruits.
c) Food Corpn. of India, Ludhiana	a) Storage of Food Grains - Rural infestation control

21.0 FOREIGN DIGNITORIES VISITED EXPERIMENT STATION, LUDHIANA

a) Prof(Dr) AGH Khattab, Head, Deptt. of Bio-Chem & Soil Science, Faculty of Agri. Univ. of Khartom, Shamat, Sudan 14-7-1977

b) Prof(Dr) JP Villasenor, Chairman, Deptt. of Bio-Tech. Universidad Metropolitana Autonomic, Mexico - 27-12-1977.

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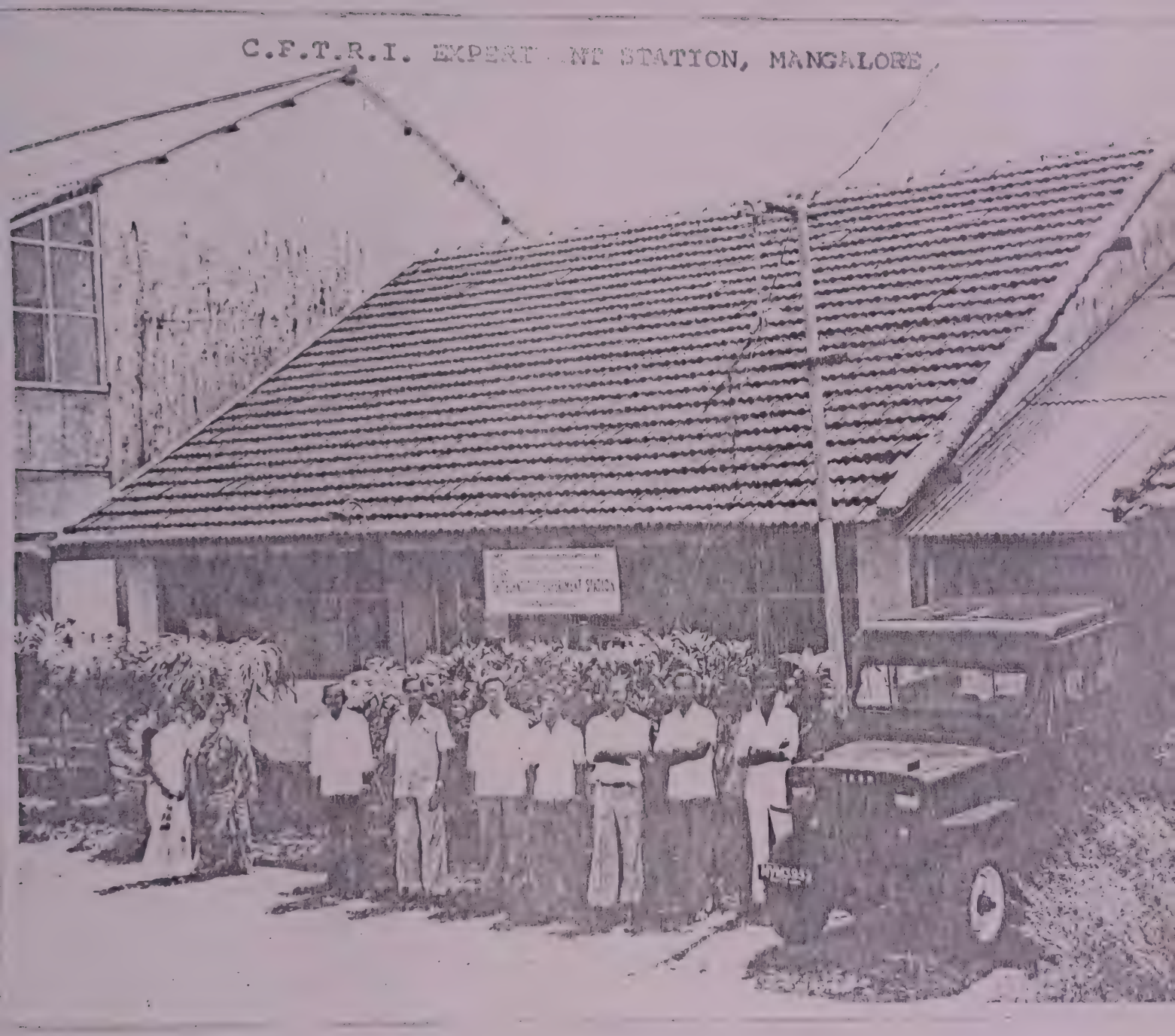
V. EXPERIMENT STATION MANGALORE

C.F.T.R.I. EXPERIMENT STATION, MANGALORE.



CFTRI Fish Technology Experiment Station
Mangalore

A Review of activities since its inception in 1960

C O N T E N T S

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Mangalore
February 1985

THE CFTRI FISH TECHNOLOGY EXPERIMENT STATION, MANGALORE

I. HISTORY AND LOCATION

1. Background: Work on fish as food, and fish processing technology was started in CFTRI, Mysore around 1956 with a small team of workers. In November 1959, with the formation of a full fledged Division of Meat, Poultry and Fish Technology, work on fish technology got some fillip. The interior, landlocked location of Mysore caused the need for seeking facilities in a suitable coastal location for work on marine fish processing. At the same time, the State Department of Fisheries considered that the setting up of a CFTRI research station for work on Marine fish, in collaboration with their own Fisheries Technological Research Station would be of immense use to them for the fisheries of the region. Accordingly, a laboratory started functioning in 1960 named CFTRI Fisheries Research Sub-Station which was renamed CFTRI Fish Technology Experiment Station, in December 1963.

2. Location: The Experiment Station is at present housed in two locations in Mangalore as follows:

(i) Laboratory facilities in the University of Agricultural Sciences (Bangalore) College of Fisheries, Hoige Bazaar Campus.

The built in area is about 1200 sq.ft. The rent is Rs.122/- p.m.

(ii) Pilot plant facilities in Industrial Estate, Yeyyadi. The built in area is about 2400 sq.ft. and rent Rs.496/- p.m.

The two buildings are 10 kms apart. Jeep (and Trailer) facility exists for transport.

3. Staffing: At present, the staffing pattern is:

Laboratory Staff	Specialisation
1. Project Coordinator Scientist EI - One	Food Technologist, specialised in marine fish processing.
2. Junior Scientific Assistant - One	Biochemist.
3. Senior Laboratory Assistant (Group III Grade 1) - One	Analyst

Auxiliary Staff	Office Staff
Junior Laboratory Assistant-1	Assistant - 1
Mechanic - 1	Lower Division clerk-1
Driver - 1	Jr.Stenographer - 1
Laboratory Helper - 1	
Night Watchman - 1	

4. Apparatus, Equipment, Books and Journals:

The laboratory is fairly equipped for routine analytical work. The Pilot Plant has developed around the facilities built for fish meal and oil, chitin and chitosan scaling-up projects.

The Experiment Station has a specialised collection of books, publications and journals related to fish and food processing technology.

II. A BRIEF SKETCH OF WORK DONE

The Experiment Station has become recognised for its contributions on: (i) the utilisation of oil-sardines, (ii) improvements in traditional curing of fishes, (iii) development of new marine fish products, and (iv) analytical and training services in analysis of fish meal and oil. The main achievments are out lined below.

1. Studies relating to quality, properties, extraction, stabilisation and utilisation of sardine oil.

Seasonal variation in content and characteristics of lipids in sardine oil.

Improvements in traditional batch rendering practice for sardine oil extraction - holding fish prior to extraction, by use of common salt and formaldehyde - preserving press liquor with formaldehyde prior to separation of oil.

Refining of crude commercial sardine oil.

Mechanism of discolouration of sardine oil - paper on the topic was awarded ROSOI prize by OTAI in 1977.

Processing sardine oil by accelerated cold clearing, solvent winterisation, fractionation of fatty acids, directed interesterification and hydrogenation.

Antioxidant effect of proteins, protein hydrolysates, amino acids and especially of proline on sardine oil. Similar effect of spices, spice mixtures and their oleoresins.

Use of sardine oil and of the fish itself in lowering serum cholesterol levels as demonstrated in cholesterol-bile salt stressed rats and in human volunteers.

2. Pilot Plant studies on fish meal and oil - Collection of extensive process data of unit operations, performance of individual units of machinery, material and energy balance, and cost economics. Two schemes for 10 tonnes/24 hours and 30 tonnes/24 hours worked out as model. Building up capability to provide complete project reports for setting up industrial

units of any capacity of raw material input upto 50 tonnes/24 hours.

Ability to offer turnkey services inclusive of engineering report, erection and commissioning of the plant and training personnel to operate a commercial unit. Consultancy to M/s Karnataka Fisheries Development Corporation, Mangalore to help set up a plant at Karwar - consultancy to M/s Karnataka Iron Works, Mangalore on long range basis on fabriction/selection of machinery.

Prawn shells from freezing plants and squilla from mechanised trawlers converted to fish meal for use as poultry feed component.

3. Improvements in fish curing - trials in association with traditional fish curers for extension of curing salt mixture and improved procedure - evaluation of field problems. Design of a model fish curing yard for streamlining production, control of sanitation and quality of traditionally cured fish. Testing polythene tents for solar drying of fish.

Preservation of mackerel and sardines by wet pickling to enable limited sundrying just prior to marketing.

Recipe and procedure for ready-to-serve fish and prawn pickles in bottles.

Quick curing by salting of picked fish meat, pressing and sundrying - end product obtained as cake or granular mince.

Dried fish minces of various types prepared from cooked press cake of fish or from picked fish meat, with or without combination of farinaceous material like potato, and with or without addition of spices.

Such products suited for use akin to dry fishes in household preparations.

4. Frozen fish products - consumer oriented, ready-to-use or ready-to-serve - helps diversify utilisation of incidental by catches of miscellanous fish and seasonal surpluses of fish, of low disposal prices. Products developed: (i) dressed fish instead of whole, (ii) Picked fish meat or fish mince, (iii) Fish fingers and fish sticks, (iv) battered, breaded fillets, and (v) fish curries. Test marketing of these products yielded good response from consumers.

5. Pilot plant for producing chitin and chitosan from prawn waste and squilla set up by Institute's Engineering group - solids from meat pulp recovered by acidulation and heat coagulation.

6. Analysis and training: Rendering analytical service to local fish industry by analysing their products, especially fish meal and oil. Training chemists deputed by industry in analytical methods.

III. A RESUME OF RESEARCH WORK ON MARINE FISH PROCESSING

The Backdrop: The Indian fish processing industry has gome to prominence on account of its commendable export performance (Amla and Sen, 1977). When we consider that both in terms of quantity and value, these exports comprise frozen fish products, primarily frozen shrimp, we get the picture that this industry is highly specialised both in terms of raw material and technology with horizontal contactplate freezing.

The marine fishery resource, however, comprises of a large variety of species. Sardines, mackerel,

Bombay duck, prawns (shrimp) form the bulk of marine fish landings. Sharks and rays, perches, sciaenids, carangids, soles, ribbon fishes, white baits and silver bellies are some of the other significant varieties. Pomfrets, seer, polynemids, flying fish and tunas rank as important table fishes, and although quantitively not significant, their importance to trade is due to their high unit value. Thus the Indian marine fish industry has a broader base potential in terms of raw material.

Marine fish landings are of significant importance to the economy of the coastal areas of the maritime States of India. An analysis of the Indian seafood processing industry (Sripathy, 1979) would show that its organised sector comprises, in the main, of the export-oriented shrimp freezing, and canning of fish products catering mainly to limited civilian urban and defence demands. Transportation of wet fish to deliver it to distant and interior markets is showing some semblance of organised effort during the past couple of years and has given some fillip to the growth of ice plants. Concepts of cold chain have been formulated for internal distribution of frozen fish and the Karnataka Fisheries Development Corporation has pioneered these efforts. The traditional cured fish products industry in the coastal rural sector has still remained a primitive occupation. Fish curing is still the most effective and economic way of saving surplus for the lean seasons. The oil-sardine based fish meal and oil industry has become an organised effort during the 70s, however, the primitive sector continuing side by side needs attention. The non-oily fish is still being converted into fish meal by pulverising crudely beach dried fishes.

The limitations for conducting research and developmental work on post-harvest utilisation of marine fishes at an interior location like Mysore, was realised soon after the Discipline of Meat, Poultry and Fish Technology was formed in the Central Food Technological Research Institute in 1959. An Experiment Station to work on the Scientific and technological problems of marine fish preservation and processing was established at the coastal town of Mangalore in 1960. This unit devoted its attention initially to work on the problems of utilisation of oil-dardines (Sardinella longiceps) and mackerel (Rastrelliger kanagurta). These two fishes together form about half the marine fish landings in India

THE OIL-SARDINES

Quantitatively the most important fishery in India, constituting a fifth of the total marine fish landings, the seasonal glut landings of oil-sardines have been converted traditionally into manure, meal and oil of poor quality due to the crude techniques of processing. Considerable amount of study towards improving the quality and utilisation of these products has been carried out at the Experiment Station.

Sardine oil: The potential for sardine oil production in India has been estimated at about 10,000 tonnes annually (Sripathy, 1972). Sen and Mathew (1975) have exhaustively reviewed the research investigations carried out in India on this oil.

1. Improving indigenous process for extraction of sardine Oil : In an attempt to improve the quality of the oil obtained by the indigenously practiced batch process of wet rendering of oil-sardines, Visweswariah recommended that cooking the fish may be continued till

the free water from the cook liquor evaporates and pressing of the cooked mass could then follow. He also suggested that the press liquor obtained by the indigenous procedure could be preserved by addition of formaldehyde to it, thus gaining sufficient time for recovery of oil (Visweswaraiah, 1969a). In another study (Visweswariah, 1969b) he suggested that dip treatment of the fish in saturated brine containing 0.4% formaldehyde (HCHO) would allow fish to be preserved at ambient temperatures of 27°-30°C for at least 24 hours in good condition. This treatment was found satisfactory from point of yield, colour and odour of the oil recovered. It has been proposed (Visweswariah, 1969c) that the fish could also be minced and the mince preserved with salt and HCHO prior to fish oil extraction.

Sen and Co-workers (1963) carried out alkali refining of commercial sardine oils with free fatty acid content ranging from 9.4 to 23.2%, on a 30 kg batch scale. The characteristics of the refined oil were very satisfactory, but as could be expected, the refining losses were as high as 30 to 55% depending upon the initial FFA. In view of the inevitable refining losses of oils with high FFA, Sripathy (1972) has suggested that indigenously produced fish oils should be refined immediately after production without resorting to prolonged storage.

2. Seasonal variations in lipids of oil-sardine fish:

Sen and co-workers (Sen and Cheluviah, 1968; Sen and Revankar, 1972) have analysed the fish off the Mangalore coast for 31/2 years. Whole fish is found to have a maximum fat content of 11.0 to 15.7% during

September to December which corresponds to the peak landing period. By January, the fat content starts declining, reaching a low 2.7 to 4.4% during June-July. Juvenile sardines occasionally landed in abundance during season are comparatively lean with 1.1 to 5.8% fat content. There is an inverse relationship between fat and moisture content of the fish, expressible for whole fish in the formula: % fat + (0.9714 x % moisture) = 75.28. As in whole fish, the body portion of the fish showed maximum fat content during September to December, decreasing thereafter. The offal had a high fat content from September to January and although lesser during February to April was still 10-12%. The relationship between fat and moisture contents in expressible in the equations: % fat + (1.120 x % moisture) = 84.92 for the body portion of the fish, and as: % fat + (0.9707 x % moisture) = 74.74 for head and entrails taken together.

The iodine value of sardine oil extracted from whole fish also varied during season, showing two peaks, once in August (171) and again in December (161). Minimum values were in October (158) and in March(149). The oil derived from dressed oil sardine, i.e. with head and entrails removed, appeared to be more saturated than that derived from offal, showing lower iodine value and refractive index and higher could point and solid fat content at 25°C.

3. Stabilisation of sardine oil: Various spices and their oleoresins are found to be effective antioxidants for sardine oil. (Revankar, 1973; Revankar and Sen, 1974; Revankar and Sen, 1975; Revankar and Sen, 1978). The spices tested included clove, black pepper,

turmeric, ginger, mustard seeds and betel leaf. Groundnut protein isolate and fish protein concentrate are also found to exert antioxidative effect on sardine oil (Sen and Padival 1970). Hydrolysed fish proteins were more effective in this regard than fish protein concentrate.

Among various amino acids tested for antioxidative effect proline was very effective. Fish protein hydrolysate and many amino acids however, discoloured the oil (Revankar, 1974a). These investigations tend to show that spices and natural constituents of fish may have beneficial antioxidant effect in processed, spiced fish products. In fact, there is experimental evidence (Sen and Bhandary,1978) showing development of water soluble antioxidative substance(s) during cooking of fish.

The experiments of Sen and Padival (1977) could at least partially explain the mechanism of discolouration of crudely produced sardine oil. They found that sardine oil turned deep brown when air was passed through it in presence of ammonia, pyridine, piperidine and ammonium chloride. The brown coloured compounds could be isolated from the discoloured sardine oil as also from the oxidised fatty acids and showed no nitrogen content.

4. Processing of sardine oil: A process for rapid winterisation of sardine oil (cloud point of 16°C) has been developed (Sen and Revankar, 1968) by which 20-25% of the oil is separated and removed as a solid mass to obtain the rest of the oil as one which remains liquid at 25°C with a cloud point 6-7°C. For solvent winterisation, acetone has been reported (Revankar, et al., 1975) to be the best

solvent. By stepwise cooling to -28°C, an oil fraction with as high an iodine value (I.V.) as 217 could be obtained starting from sardine oil of I.V. 176. Sardine oil contains about 3-4% trisaturated triglycerides and about 24-30% saturated fatty acids. By directed interesterification, the saturated fatty acids could be regrouped to form trisaturated triglycerides which could then be easily removed by solvent winterisation at - 5°C. When sardine oil was hydrogenated at atmospheric pressure, its typical odour disappeared and the oil became stable at I.V. of 100 (Sen and Revankar, 1968). Fractionation of fatty acids of sardine oil by urea adduct method has been reported (Revankar, 1974b).

5. New uses of sardine oil: Stearin-free sardine oil of good quality has been used singly and in combination with refined groundnut oil as packing medium in canning of oil-sardines. Fish packed with 1:1 blend of the two oils was preferred by tasters (Sen and Revankar, 1971).

Sardine oil was found to have highly significant hypocholesterolemic effect in cholesterol-bile salt stressed rates. The oily fish also had such effect (sen, et al. 1974). When sardine oils with different degrees of unsaturation were tested on such rats, a significant correlation was observed between iodine value, ratio of poly-unsaturated to saturated fats and the logarithm of terminal serum cholesterol levels (Sen, et al., 1976). The study was extended by way of administering sardine oil to human volunteers and it was found that the oil lowers serum cholesterol level significantly (Narasimha Rao, et al., 1977).

Fish Meal and oil: The different aspects that are basic to the oil-sardine based fish meal and oil industry in India have been examined by Sen and his colleagues(Sen and Dani, 1968; Sen and Sripathy, 1968; Sen, 1972). In the late sixties, against the background of a situation when glut landings of this fish were being traditionally converted into manure, guano and oil by crude methods along the S-W coast of India obtaining end products of poor quality suitable only for inferior uses, a Pilot plant aimed at bringing in the known techniques of a continuous wet reduction was set up (Sripathy and Ahmed, 1978). This experience has been utilised to render technical advice to Messrs Karnataka Fisheries Development Corporation, Mangalore for setting up a fish meal and oil plant at Karwar and to an entrepreneur for fabrication of the plant.

Prawn shell from freezing plants and squilla from mechanised trawlers have been converted into fish meal for poultry feed. (Visweswariah, et al., 1966).

Chemical analysis of fish meal and oil is being undertaken at the Experiment Station in regard to commercial samples brought to the laboratory by the industry and trade (Sen and Keshava, 1971; Sripathy and others, 1976). The result of such analysis form the basis for rendering advice to the industry on aspects of quality.

CURING OF FISH

Sundrying of salted, brined, or fresh fish has been extensively adopted traditionally all along coastal regions. Curing of fish by such means is still the most economical way of saving seasonal and local surpluses of fish for off-season marketing, accounting for

nearly a fifth of the marine fish landings. However, the conditions under which the fish is cured render it susceptible to mold growth, red halophiles, development of yellow or brown discolouration and rancid and off odours during storage. Besides, the cured fish is contaminated with sand. When cooked, it is tough in texture and often has bitter taste. Studies on market samples have borne out these drawbacks(Sen, et al, 1964).

As a result of extensive studies on curing of mackerel, an improved method for salt-curing and sun-drying of fish involving use of a curing salt mixture, has been worked out (Sen and Sripathy, 1967). Suggestions for streamlining of production control of sanitation and quality have been outlined (Sripathy, 1967). For artifical drying of fish, it has been suggested that design of driers based on locally available combustible materials like paddy husk, hay or other agricultural wastes may more suit a rural setting (Sripathy, 1978). Polythene box and tent driers inside which salted fish is laid out for sun-drying have been tested (Sripathy and Balasaraswathi, 1982a,b).

An attempt was made to carry the laboratory findings on fish curing to field application. Mackerel was cured by the improved method (Sen and Sripathy, 1967) under field conditions where the facilities were given by two private fish curers at Kulai and Sasihithlu in Dakshina Kannada. An evaluation of the field trials showed the many constraints that operate in taking laboratory results to field application. In the main, the curers- whether on home scale or large scale-- take risks and work for

even low but quick returns on their working expenses. The commerce in the product operates as a speculative trade depending upon quick change of hands from the primary producer to the trade channels. While the merits of our improved method were appreciated, a longer storage life and hygienic quality does not seem to benefit the primary producer by way of increased returns (Sripathy, 1982b).

PRODUCT DEVELOPMENT

A number of consumer oriented and other products based on marine fish have been developed from time to time at the Experiment Station. The main objective has been to propose various ways in which incidental by-catches of miscellaneous fish and seasonal surpluses of fish, all of low disposal prices, could be utilised.

1. Preservation by pickling: Recipes and procedures for fish and prawn pickles packed in bottles have been worked out and the details furnished to interested parties. Mackerel and sardines have been preserved in brine after an initial salting. The fish so held are to be surface dried in the sun for a short time before marketing (unpublished).

2. Dried products (Sripathy, 1978): Eviscerated, cooked, pressed oil-sardine extruded through a meat mincer was dried and obtained as dehydrated fish mince. This product was given different treatments during preparation as follows: (a) tamarind added during cooking, (b) tamarind mixed with press cake in two different proportions, (c) turmeric added to press cake, (d) tamarind added to press cake and smoked, (e) dried minced and smoked, and (f) control, without any treatment. These variants of the product were kept

in aluminium pouches and remained acceptable, in general, even after an year of storage. The rationale of the various treatments was our earlier observation that such treatments serve to improve the acceptability and stability of the product. The products were incorporated at 5% and 10% levels in a mung dhal preparation for serving, tested for consumer acceptability and found acceptable.

Fish mince has been worked into an excellent product in the form of dry granule, based on a spiced fish-potato combination. Another variant was prepared from press cake of cooked fish which was mixed with fried onion, spices and salt and sundried.

Picked fish meat, from pink perch and sole, was mixed with common salt in 1:1 or 2:1 proportions w/w, set aside for an hour, spread into a frame partitioned into rectangular compartments of 1"x1" size and pressed in a manual press. The rectangular pieces were sundried to a final moisture content of 10%. A slightly different product was obtained by mixing 20% salt to picked fish meat, setting aside for an hour, pressing in a basket press, mixing with fried onion and spices and sundred.

These dried, minced fish products have been found suitable for use like dried fish, in household preparations like curries, chutneys and soups.

Silver bellies, boiled in saturated brine for 2-5 mins and sundried, yields a product that stores better and is less susceptible to fungal and insect infestation than traditionally cured silver bellies.

3. Frozen fish products: (i) Dressed and frozen fish: Mackerel and pomfret which are both developing good market in frozen whole form were frozen dressed, with the gills and viscera removed. The dressed fish were evaluated without and with glazing treatments with salt, sugar and polyphosphates. For comparision, round fishes were also frozen. Storage studies based on organoleptic evaluation showed the feasibility of marketingthese fishes in this precleaned, ready-to-use form for the convenience of the consumer.

(ii) Frozen fish mince: A variety of fishes such as croaker, snake fish, lizard fish, pink perch, sole fish, cat fish, white bait, silver belly and others were evaluated for their yield of picked meat and general acceptability on frozen storage. The fish mince blocks were glazed with glazing compositions and packed in polythene pouches. The products were found to be acceptable in laboratory organoleptic tests. More detailed studies have been carried out with cat fish on the effect of holding conditions, prior to picking of meat and freezing, on the frozen storage stability (Revankar, et al., 1981).

Various ways in which picked fish meat could be utilised have been delineated (Ben and Bhandary, 1972).

(iii) Frozen fish fingers and fish sticks (Sripathy, 1978): fish mince blocks while still frozen are then quickly battered, breaded individually, packed and frozen stored. These are fish fingers. For preparing fish sticks, fish mince is thoroughly mixed with vegetables, cereals starch, spices and salt. The mass is spread in rectangular molds of the same size as fish fingers and frozen.

After this initial freezing, individual sticks are battered, breaded, packed in polythene wraps and frozen stored.

Both fish fingers and fish sticks are ready to serve and fry products which are readily accepted.

(iv) Frozen, breaded fillets (Sripathy, 1978): Mackerel and croaker fillets were battered, breaded and frozen. The products kept well in cold storage upto 9 months. These are also ready to fry and serve.

(v) Frozen fish curry: (Revankar, et al., 1979 and Revankar and Baliga, 1982). Recipes, pack size and freezing procedures have been worked out for sardine, mackerel, seer, shrimp, mussel, and fish mince curries. The main steps in the preparation of frozen fish curries are: (i) preparation of fish, (ii) preparation of gravy, (iii) packing fish and gravy in predetermined proportions, (iv) freezing, and (v) packing, sealing and frozen storage. It appears feasible to prepare the curries with or without precooking of the fish, but from the point of overall sanitation and better stability in frozen storage, it seems desirable to do the precooking. Consumer size packs of the different curries were test marketed at Mangalore and Bangalore. The products were well received.

4. Other products: (i) Chitin and chitosan from squilla and prawn waste. Based on laboratory trials at the Institute at Mysore for the preparation of chitin and chitosan from prawn waste and squilla, the engineering group of the Institute set up a pilot plant at Mangalore for a study of the scaling up of operations and economics of production. The process has been registered with the National Research Development Corporation for commercialisation.

(ii) Recovery of proteins from squilla and prawn waste: Shrimp waste and squilla were analysed for water soluble, heatcoagulable, non-protein and chitin nitrogenous fractions. Trials were conducted on mechanical separation of carapace matter and meat. Heat-coagulation, lye treatment and proteolysis were also tried as other means of protein recovery. The best recovery of proteins was obtained by mechanical separation and the least by enzymatic proteolysis. Trials on recovery of solids from squilla pulp obtained from the meat separator indicate that the proteins can be recovered by slight acidification, heat coagulation by boiling and filteration.

(iii) A shrimp broth (Revankar, 1978): An attempt was made to prepare a broth for use as a flavouring adjunct from prawn waste collected without lapse of time after peeling, from freezing plant. The product was stable and microbiologically safe.

(iv) Fish protein hydrolysates (Sripathy, 1975): The process worked out for obtaining soluble fish protins by enzymatic hydrolysis is, no doubt, applicable to all species of fish. The organoleptic properties of the final product need considerable improvement before it can be incorporated in food formulations. Other uses for the hydrolysates need to be developed.

CONCLUDING REMARKS

The foregoing account of the work of CFTRI Fish Technology Experiment Station is based mostly on published papers in the appended list which are referred to in the text. The experiment station has become known for its contributions on:

(i) the utilisation of oil-sardines,

(ii) improvement in traditional curing of fishes,

(iii) development of new marine fish products, and

(iv) analytical and training services in the analysis of fish meal and oil.

The problems of R&D that may now receive priority are those relating to improving the keeping quality and transportation of wet fish (Sripathy, 1973), quality control of fish and fish products for internal marketing (Sripathy, 1978) and extensive field trials on new innovations and new products (Sripathy, 1976 and 1977) in the overall context of need for improving research utilization in fish processing technology (Sripathy, 1982a).

IV. HIGHLIGHTS OF OTHER ACTIVITIES

Analysis and Testing: Samples of fish meal, fish oil and other allied materials brought by industrial units and commercial enterprises are being chemically analysed on a regular basis. The particulars of the samples analysed during the past couple of years are given in the table overleaf. A feature of this analytical service is that the parties who get the samples analysed, also seek to know about and discuss about the quality of their materials in relation to the results of analysis.

Year	No.of Parties	No.of samples	sample material	Total analysis fee collc
1980-81	20 11 4	87 104 4	Fish meal Fish oil Coconut oil cake, rubber seed oil, chikki powder, tapioca chips	Rs.7,710/-
1981-82	19 13 4	81 343 5	Fish meal Fish oil Whole fish, dry fish, coconut shell powder, Wheat	Rs.10,625/-
1982-83	28 17 9	126 120 21	Fish meal Fish oil Hardened oil, rice bran oil, dry fish, prawn shell meal and powder, squilla powder, dried shrimp, fish cake, dried cuttle fish	Rs.10,545/-
1983-84	35 8 7	267 125 13.	Fish meal Fish oil Hardened fish oil, hardened rice bran oil, tallow, cocoa bean, coconut oil cake, dried prawn head, squilla powder dry fish.	Rs.17,295/-

Training Quality Control Chemists deputed by Industry:

As and when demand arose from industrial units for the training of their chemists in analysis of fish meal and oil, such training has been imparted. The details in this respect are given in the statement annexed here.

Sl No.	Dates and duration of training From To	Training charges
1.	2-9-74 - 20-9-74 3 weeks	Rs.275/-
2.	1-7-76 - 28-7-76 4 weeks	Rs.1000/-
3.	22-11-76 - 10-12-76 3 weeks	Rs.500/-
4.	1-8-79 - 17-8-79 10 working days	Rs.250/-
5.	1-8-79 - 17-8-79 10 working days	Rs.250/-
6.	5-11-79 - 16-11-79 10 working days	Rs.250/-
7.	17-12-79-21-12-79 5 working days	Rs.100/-
8.	31-12-79-17-1-80 10 working days	Rs.250/-
9.	21-7-80 -22-8-80 4 weeks	Rs.1000/-
10.	6-7-81 - 17-7-81 2 weeks	Rs.400/-
	-do-	Rs.400/-
	-do-	Rs.400/-
	-do-	Rs.400/-
11.	21-12-81 - 24-12-81 4 days	Rs.150/-

Consultancy: Comprehensive technical assistance was given to M/s Karnataka Fisheries Development Corporation, Mangalore, to set up a 30 tonne fish meal and oil plant based on oil-sardines (30 tonne fish per 24 hrs) at Karwar. The services rendered included selection and design of equipment and machinery, planning and supervision of plant layout and initial production. For this plant, design and fabrication advise was given to M/s Karnataka Iron Works, Mangalore. Both the parties are NRDC licensees for our process. The plant has now been in full production for 3 years.

Technical Enquiries: Technical information is provided to industrialists, government departments and other agencies against their enquiries by mail and personal visits. Such enquires averaging 15 to 20 per year cover various aspects of fish and food processing.

	Deputa tion	Subject, place and durtn.
Sri. N.V.Sripathy -Sponsor		
1.	Australian Association for Science Corporation in Asia	For participation in "Solar Fish Drying project" in Dacca, Bangladesh, Dec.9-20, 1976
2.	FAO	To visit selected Fish Technology Institutions in Bangkok, Colombo, Dacca, Jakarta, Manila, Serdang and Singapore for study of the Current Research Programmes in the IPFC Region on "Traditional Fish Products", March 23 - April 22, 1982.
3.	FAO	IPFC Workshop on Dried Fish Products and Storage, Selangor, Malaysia, Nov. 2 - 5, 1982.

Kum.M.Balasarswathi -

Summer Institute in "Utilisation of Under-utilised fishes and fish wastes", UAS College of Fisheries, Mangalore, July 2-31, 1979.

Training Course in "Quality Control of Frozen Lobster Tails", Marine Products Export Development Authority, Cochin, Oct 3-10, 1983.

Miss Lalitha Baliga B. -

Summer Institute in "Utilisation of Under-utilised fishes and fish wastes", UAS College of Fisheries, Mangalore, July 2-31, 1979.

V. LOOKING AHEAD

The organised sector of marine fish processing industry in the country comprises: (i) the export-oriented contact-plate based, shrimp freezing industry, and to a much lesser extent, other crustaceans and fishes, and (ii) the canned fish industry catering to civilian markets in urban centres and defence requirements. Transportation of wet fish to deliver it to distant and interior markets is showing some semblance of organised effort during the past couple of years and has given some fillip to the growth of ice plants. Concepts of cold chain have been formulated for internal distribution of frozen fish and the Karnataka Fisheries Development Corporation has poineered these efforts. The traditional cured fish products industry in the coastal rural sector has still remained a primitive occupation. Fish curing is still the most effective and economic way of saving surplus for the lean seasons. The oilsardine based fish meal and oil industry has become an organised effort during the 70s although the primitive sector continuing side by

side needs attention. The non-oily fish is still being converted into fish meal by pulverising crudely beach dried fishes. Except in freezing and canning, the level of entrepreneurship in fish based industries and the socio-economic conditions of the fisherman community are both poor and needing support.

The exploitation of fishery resources in the economic zone would not only yield hauls of additional food fish, but is also expected to result in landings of fish of low market value or of unfamiliar fish of no market value at all. Thus the need to develop utilisation alongside exploitation cannot be overemphasized in the context of harvesting available marine food resources.

Organised research in the field of marine fish processing in being carried out for just over two decades now. The need for utilisation of researsh in fish handling, marketing, distribution, preservation and processing is as great as it is urgent. Our pilot plant experience in fish meal and oil has given us definite indication that the scaling of operations as integral to laboratory efforts is a pre-requisite for taking laboratory findings nearer to actual application. Similarly, field trials in taking laboratory developments in improvement of traditional fish curing has given the insight that we have to reckon with socio-economic factors that determine the pattern of production and trade, in order to enable to achieve positive results. The R&D effort of the laboratory work bench has to be developed to the stage of providing a turnkey job; extensive field trials and specific training on new products, new processes and

innovation will have to be organised by the labora-tory itself. Thus, scaling up of operations, carrying out further studies and test marketing of products developed, and use of extension and demonstration as positive tools for research utilisation are the main areas where thrust must be applied so as to achieve cognizable results. This calls for far greater inputs by way of infrastructure and staffing than now available.

Against this background, the expansion and growth of the Experiment Station is imperative for adequate efforts in research utilisation in the field of marine fish processing technology, by: (i) Assessing indigenously developed know-how to date for intrinsic potential for adequate expansion;
(ii) Filling gaps in basic and applied information and knowledge required to carry earlier efforts to a stage of utilisability;
(iii) Identifying areas of R&D which have greater short-range and long-range potential for actual exploitation, and (iv) Developing extension services.

Besides marine fish, processing of cashewnut and cashew fruit, cocoa, arecanut, coffee curing, pineapple products, parboiling and milling of rice, coconut oil production are all of relevance to the region. Post harvest storages of agricultural and plantation crops, production of meat in streamlined and hygienic layouts need attention. Extension work in all these areas should be undertaken in the region.

The present infrastructure and staff position at the Experiment Station need to be considerably improved.

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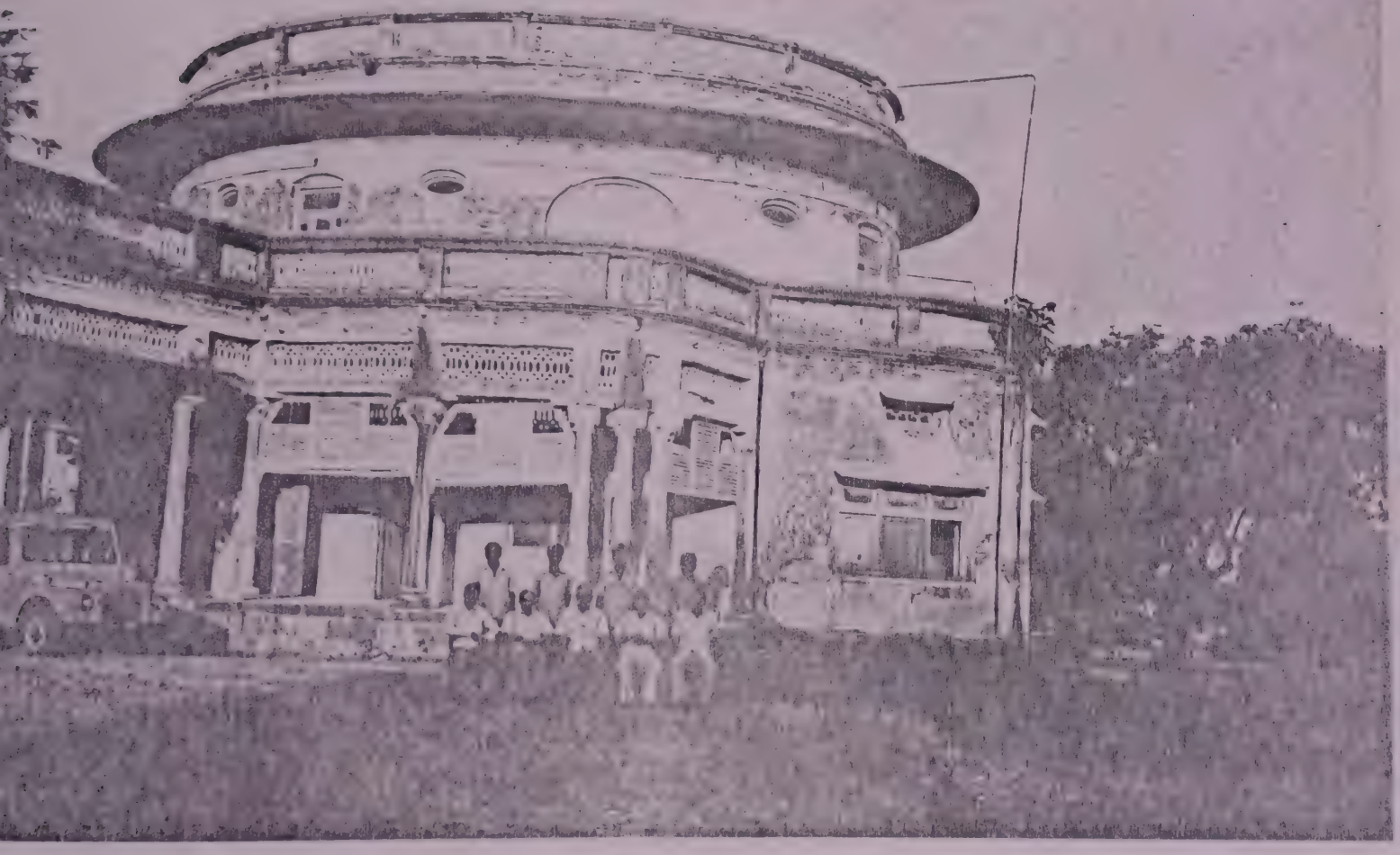
VI. EXPERIMENT STATION NAGPUR

C.F.T.R.I. EXPERIMENT STATION, NAGPUR



S U M M A R Y

The Central Food Technological Research Institute, EXPERIMENT STATION, Nagpur was established in the last quarter of 1960. The objectives of the Experiment Station in short are - to carry out Research Development and Consultancy work on the Regional Problems, undertake Extension work of the Products/ processes developed by the Experiment Station as well as the CFTRI, to identify problems for feeding to the Institute, and to render technical guidance/assistance to the Food Industry, entrepreneurs etc. The region covered by the Experiment Station is Vidarbha, Marathwada and Khandesh of Maharashtra and Madhya Pradesh.

The EXPERIMENT STATION, Nagpur has all along been catering to the needs of the people of the region by way of Research & Developmental activities, including the tasks assigned to it. Sixteen well identified projects are completed and their findings extended in the region as well as outside. Nagpur enjoys a very prominent position as a Citrus growing Centre and Nagpur oranges are famous all over the Country. Exhaustive work on oranges - canning and processing, preparation of Ready to Serve drinks and stable orange flavour emulsion, enhancement of their storage life for Up-country markets as well as exports and preparation of various products from the citrus fruits has been carried out. The most significant contribution has been the Export of oranges through the sustained efforts of the Experiment Station. The decay causing organisms have been identified and remedial measures i.e. application of fungicidal wax emulsion extended. The process of Wax emulsion

manufacture has been taken up by three parties through N.R.D.C. A design of commercial wax applicator-cum-dryer has been prepared for large scale handling of oranges. A Triple Roller Extractor has been designed and fabricated for the efficient extraction of orange oil from the orange peels.

Varietal trails on other fruits/vegetables like peas, Tomatoes, Potatoes, Custard Apple etc. have also been carried out and recommendations made to the Industry.

Large quantities of chillies are grown in and around Nagpur. A local variety of chilli known as 'BHIWAPURI CHILLI' is cultivated in Umred Taluqua. The growers/cultivators faced the problem of sun-drying their produce specially in the wake of inclement weather. At the instance of growers/traders and Zilla Parishad Authorities, work was taken up by the Experiment Station in this direction. An Emulsion has been developed and recommended for checking the chillies before drying. This treatment reduced the drying time to about 1/3 of the time required in the traditional practices. A Tray Tier System has been evolved to dry the chillies in bulk for quicker drying and saving in drying space. The chilli trade has received an impetus and the suggested method adopted by them. The Government of Jammu & Kashmir has adopted the method of chilli drying in their region, where the temperatures are low.

The other important land mark in the drying technology has been the development of a FLUIDIZED BED DRYER for dehydration of food articles, specially of granular shape. Dehydration of paddy, garlic, ginger, chillies etc. has been successfully tried.

The development of F.B.D. has paved a way for further work and students from the Technology Institutes have benefitted by carrying out Research Work. Design of a commercial F.B.D. dehydration plant has also been prepared and its drawings supplied to Research Institutes and Entrepreneurs. One such plant is under fabrication.

Considerable quantities of onion are grown in Nasik District of Maharashtra. A survey of the onion growing region with a view to identify the problems was carried out and improvements in the curring practices and storage of onions has been suggested and constructed by the AADF Nasik as per the Technical Advice/guidance rendered by the experiment station. Large quantities (1,500 tonnes) of onions are being stored in the Store Houses designed by the experiment station. The suggested improvements in curing and storage practices have reduced the spoilage of onions, from a s high as 40% to less than 10 per cent, pa rticularly during the rainy season. The Leaf cover and Bunch hanging methods developed by the experiment station has been adopted by AADF who are also doing its Extension work in Nasik District.

A Friction Type Extruder has been designed and fabricated. Its operational trials are being carried out by the P.T. Discipline, CFTRI, Mysore. Nutritional as well as Extrusion qualities of Finger shaped snack Foods were improved by incorporating composite blends of Maida, Potato, Sweet Potato Flours, Germinated Mung and millets, alongwith defatted Soya and Groundnut Flours. The Product is ideal for consuming after deep frying or Toasting.

Techno-Economic surveys of Vidarbha, Four Districts of Madhya Pradesh were undertaken to recommend establishment of Food Processing Units on the basis of availability of raw material, infrastructural facilities and market potential.

Surveys of Onion Growing Region of Nasik District as well as the Turmeric producing District of Sangli were conducted and problems associated with the Trade identified for undertaking Research work.

The Experiment Station, has the credit of publishing Eight Research Papers and two have been communicated to the Editor of Indian Food Packer for publication. Four papers have been presented at various seminars/symposia.

Demonstra-tion of the Wax Coating of Nagpur Oranges, Sun-drying of chillies, Fluidized Bed Dryer, Leaf Cup Making Machine, Preparation of Gold Fingers, Pest Proofing of Grain Storage Bags, Hot Water Treatment of Mangoes, a few to mention, were arranged.

The Food Processing Industry in the region was rendered Technical Assistance by way of Technical Advice and Analysis of their products for quality improvements etc. The number of Food processing Units in the region has increased to about 12 recently.

OTHER ACTIVITIES OF EXPERIMENT STATION:

Supply of products, Replies to Technical querries as well as Technical Assistance to the Industry in the region. Seven important processes for the preparation/manufacture of products developed by the experiment station as well as the Institute have been

released to a number of Parties. These include -

1) Ready Mix for Quick Curd
2) Simple Wheat Milling
3) Instant Jamun Mix
4) Pectin from pectin containing meterial
5) Leaf Cup Making Machine
6) Tamarind Juice Concentrate
7) Process for Wax-emulsion preparation

Three Staff Members (Tech) of the experiment station have the credit of the award of Degree of 'Doctor of Philosophy' by the Nagpur University, Nagpur.

The Station, at present has four projects on hand - one each on Rice, Dal, Soya Beans and Utilization of Cannery Waste.

C O N T E N T S

INTRODUCTION:

The Central Food Technological Research Institute, Mysore established eight regional Experiment Stations in fulfilment of the second five year plan allotted by the Planning Commission for an orderly growth of the fruit and vegetable preservation industry in the country. The Nagpur Experiment Station (formerly called Regional Research Station) was started at the factory premises of M/s Nagpur Orange Growers Cooperative Association Ltd., Nagpur, during the last quarter of 1960. It was shifted to its present premises (rented) on 17th May, 1962. The scope of the Experiment Stations was widened in 1965 to cover the entire food processing industry in the country. The re-defined aims and objectives of the Station are -

1) To act as out-posts of the main Institute in the respective regions for feeding regional information and developments as well as identified problems.

2) To carry-out research work on regional problems in collaboration with the main Institute.

3) To carry-out extension work on products/processes developed by the Institute.

4) To render technical guidance and assistance to the food processing industry, entrepreneurs etc. and to do liaison work between the Institute and the various developmental agencies, commercial organisations and associations etc. in the region.

The region covered by the Nagpur Experiment Station comprises of Madhya Pradesh and Vidarbha, Marathwada and Khandesh of Maharashtra.

A resume of research and development work done at Experiment Station, Nagpur, from 1961 to 1984 is briefly outlined as follows:

RESEARCH AND DEVELOPMENT PROJECTS:

I. FRUIT AND VEGETABLE TECHNOLOGY:

1.0 NAGPUR ORANGES:

1.1 Studies on the post-harvest storage life of Nagpur oranges:

The micro-organisms for the post harvest decay in Nagpur Oranges were identified and these are - (i) Phytophthora citrophthora (brown rot), (ii) Gleosporium Anthracnose rot) (iii) Alternaria citri (Stem-and rot), (iv) Oospora citri - Geotrichum candidum (sour rot), (v) Penicillium species (Blue & Green mould), (vi) Actinomycetes species (associated with anthracnose rot), vii) Asperigillus niger (Aspergillus rot) and (viii) an un-identified organism. The incidence of sour rot was maxium in Ambia Bahar oranges.

1.1.1 Treatments with fungicides etc.:-

Treatments with various fungicides namely- Captan, Brassicol, Benlate-50, Thiobandazole, Para-hydroxy-benzoaic acid, S.O.P.P., Antibiotic - namely Aureo-fungin and growth regulator namely - 2, 4-D, were tried not only singly but also in combination with each other. These were also tried after incorporation in Waxol-o-12 for both Ambia and Mrig seasons. The most effective fungicide to minimise decay in Nagpur Oranges was found to be Benlate-50 in conjuunction with waxol-o-12. This treatment extends the storage life of Nagpur Oranges upto 18 days under ambient conditions. It was followed by Thiobendazole. However, none of these treatments were able to check fully the decay due to sour rot.

Since the decay in Nagpur Oranges was found to be of systemic nature a double pronged attack of pre and post-harvest treatments was tried. The fungicides Used in pre-harvest treatment on the selected trees in three orchards were- Blitox, Captan, Dithane-Z, Benlate-50 and water. The post-harvest treatment comprised of treatments of oranges with 6 per cent waxol-o-12, containing 500 ppm Benlate-50. Recent work has shown that a combination of 1000 ppm Calixin and 0.1% Benlate-50, after incorporation in 5% wax emulsion is the most effective treatment for minimising spoilage not only due to sour rot but also due to Pencillium(Blue and Green) and Aspergillus niger. The immersion of fruits for 2 minutes in the combination of the two fungicide aqueous suspension at the same doses is also effective in minimising decay due to sour rot, however, the fruits packed in ventilated wooden cases lost their marketability after seven days under static ambient storage.

1.1.2 Packaging:

Oranges packed in traditional packaging cases suffered losses to the extent of 40 per cent during long distance transport to places like Mysore and Delhi, due to physiological breakdown as well as decay. An improved ventilated wooden packaging case as well as a cardborad cartonwere evolved in collaboration with Packaging Technology Discipline to minimise the losses during transports of oranges to long distances as well as export. Paper pads containing tanas (dry grass) were used to avoid contact of the tanas directly with the fruits with advantage.

1.1.3 Transport:

Trials of treated as well as un-treated oranges packed in traditional and improved wooden packaging case as well as card-board carton to distant out stations like- Mysore, Calcutta and Delhi were carried out for assessing the extent of losses. The improved wooden packaging case and use of paper pads in between layers as well as cardboard carton were found functionally superior to traditional packaging practices. Pre-treatment with 6 per cent waxol containing 500 ppm Benlate was also found to be most successful for transport of oranges in improved wooden case as well as card-board carton. The pre and post-harvest treatments in order of performance are listed below:

1) Three pre-harvest sprays with water and captan and an additional benlate spray a day before the picking of fruits were found to be advantageous in checking the deday level up to 20 per cent, as compared to 37.7 per cent in the un-treated fruits;

2) Three pre-harvest sprays with captan or Dithane and an additional Benlate spray a day before picking of the fruits followed by post-harvest wax treatment containing 0.1% Benlate lowered the decay level to 9.5% and 10.7% respectively upto 12 days storage as compared to 31.8% per cent in the untreated fruits;

3) Three pre-harvest captan sprays plus benlate spray a day before picking of the fruits followed by post-harvest treatment with 6% wax emulsion containing 0.1% Benlate was, however, found to be the most significant treatment as the deday level was 11.0% as compared to 37.7% in untreated fruits on 18 days storage.

An economic benefit of 3 to 5 rupees per case was acrued to the growers by the use of treated oranges (6% waxol containing 500 ppm Benlate-50) packed in ventilated wooden cases as well as cardboard cartons on transport to Delhi.

1.1.4 EXPORT PROMOTION OF NAGPUR SANTRA:

Technical guidance to the Nagpur District Agri-Culture and Industrial Co-operative Society Ltd., Nagpur for fungicidal wax treatment of oranges, packing them in ventilated cardboard and plywood cartons and handling of oranges for export was rendered. Export of oranges from the region commenced during 1976 and a total quantity of 1,258 tonnes (@ Rs.1,200/- per tonne; ex. orcahrd) valued at Rs.15,72,500/- was exported to Iran and Dubai. The consignment included 10 tonnes of fungicidal wax treated oranges on a trial basis and it is reported by the Society that the treated oranges were preferred than the untreated oranges. As a result, the quantity of fungicidal wax coated oranges was progressively increased in future export consignments.

1.1.5 Extension work:

The process of treated oranges with 6% waxol containing 500 ppm Benlate-50, was demonstrated at various places like Warud, Wadegaon, Kohli, Bhiwapur, Pipla, Khairi and Nagpur. The process has been taken up by a number of growers in the region and is commercially used. The process of waxol preparation has been released to M/s. A.J. Chandak, Amraoti through NRDC in October,76. The party has since started commercial sale of waxol-o-12.

1.2 Design of Wax Applicator:

A wax applicator with capacity to treat 50,000 fruits per day has been designed. The applicator is estimated to cost about Rs.72,500/.

1.3 Utilization of culls and orange waste:

1.3.1 Physico-chemical characteristics:

Physico-chemical characteristics of culls and orange waste right from three months stage of growth to the stage of picking of matured fruits have been determined. In regard to the orange waste, emphasis was laid on the peel oil and the pectin content.

1.3.2 Triple Roller Extractor for peel oil:

A Triple Roller Extractor was designed and fabricated at the Institute workshop at Mysore. The performance trials of the T.R.E. have shown an improved yield of orange oil (more than 65 per cent) as compared to 50-60% obtained by the use of Twin Roller Extractor and Pfumaterice on passing the peels twice through them. The recovery of oxygenated compounds was also found to be higher (0.63 per cent) as compared to commercial extractor (0.4 per cent). The Triple Roller Extractor has thus been found to give better performance qualitatively as well as quantitatively over the commercially used peel oil extractors. From the enquiries received it is observed that keen interest for the purchase of the Triple Roller Extractor has been shown.

1.4 Carbonated Orange Drink:

A carbonated orange drink (based on concentrated ornage juice) containing 20 per cent orange juice was prepared and standardised. A flavour emulsion based on mandarin cold pressed orange oil was also used as flavouring material in the drink for comparative studies. The carbonated drink has a shelf life of 6 months under ambient conditions and found to be of good quality as per sensory evaluation report of an expert panel as well as the local market.

A ready-to-serve beverage containing 20 per cent juice (non-carbonated) has also wide acceptance and Messars NOGA, Nagpur of the M.A.I.D.C. Bombay, have, after paying a consultancy fee of Rs.10,000/-, started the commercial production of this beverage.

1.5 Curing of oranges for canning segments:

Freshly harvested oranges are generally 'cured' by stacking for some time before using them for canning as segments. It was found that considerable spoilage (13.2 per cent in Mrig corp and 14.57 per cent in Ambia Bahar Crop) occurred while curing for 5 days at room temperature. The driage of fruits was about 1 per cent daily.

Blanching of the fresh orange segments for 2 minutes in water showed similar effects and 'curing', the 'in process' and 'in can' breakage of segments were considerably reduced.

Blanching made the segments more bitter when oranges from early crops were used. However, no bitterness was noticed with oranges from the middle and end of the season. Blanching can thus safely replace wasteful and tedious process of 'curing' in middle and end season of oranges.

1.6 Canning of Mandarin Orange Segments:

Canning of mandarin orange (Citrus reticulata) segments using varying fill-in-weight of segments and covering syrup strengths was tried from oranges of Ambia and Mrug Bahar crops available in Nagpur region. The drained weight was directly proportional to the fill-in-weight of segments and inversely proportional to the strength of the covering syrup. Reverse was the position with respect to cut-out syrup brix. The

combinations of fill-in-weight and covering syrups which could give the required standards of 50% drained weight and cut-out syrup of 19°brix were identified. Mrug crop oranges gave higher drainedweight and cut-out syrup brix than Ambia Crop. Drained weight kept decreasing upto 5 months storage at ambient temperature, except in packs where TSS contributed by the covering syrup was more than twice the TSS contributed by segments. Lower concentrations of covering syrup, where TSS contributed by covering syrup was less than TSS contributed by filled segments, gave whitish turbidity in the cut-out-syrup. Ascorbic acid loss was 23.46% during canning and 35-40% on storage for 10 months. Mrug Bahar oranges showed more breakage in canned segments than Ambia Bahar. Absorption spectra of carotenoids showed loss of colour on canning and more colour in canned Mrug Crop segments than Ambia crop segments. Texture suffered badly with covering syrup of higher concentrations, above 50°brix. Lower concentrations of covering syrup, 20-30°brix, maintained better texture but the product was poor organoleptically.

1.7 Investigations on the preparation of pectin from orange Pomace:

The optimum conditions for extraction of pectin by alcohol precipitation method from pomace were standerdized. The effect of Blanching and pH of extracting media on the quantity and quality of the pectin was investigated. The yield of pectin was highest when the pH of extracting media was 1.6, and blanching of pomace did not have any effect on quality. Large quantity of pomace after washing were dehydrated for use in the off season. Large scale experiments on extraction of pectin from pomace were conducted in collaboration with F&VT Division of the Institute and a detailed scheme was provided to M/s NOGA UNIT, for setting up a pectin plan

1.8 Spin-pasteurizer:

The spin-pasteurizer, developed at the Institute, was found to be most suitable for orange segments, and gave better results as compared to Rocking Pasteurizer in reducing the breakage of segments by 50 per cent and the product retained better flavour and crispness.

2.0 Varital canning trials of fruits & vegetables:

2.1 Tomatoes:

Thirty-one varieties of tomatoes were selected (from 50-60 varieties sown in Agriculture College Farm, Nagpur) on the basis of colour, texture, size and surface of the fruits and tested for their canning suitability. Only fully mature and red fruits were taken for canning as whole tomatoes. Fruits from 2-3 different pickings were tested to cover the variation due to time of canning during the season. Addition of 0.1 per cent calcium chloride was also tried to test its effect in preventing disintegration of tomates. The physico-chemical characteristics of fruits were also followed over different seasons.

Study made for 4 seasons showed that the varieties red top (pear shape), Ruth (oblong), Early chatham, Sunmarzano and best of all were most suitable for canning as whole tomates (breakage, practically nil), followed by Tuck Queen, Tukon, E.C. 14166, Money maker, Market King, Turi Alba and New Hampshire. The varieties Pusa Ruby, Vokal, Ailsa Crag, Tip top, Sioux, Poona 341, Meerti, I.E. 19, Type 9, Ruth X Red top, Ogier, Dalvin's choice and Hybrid 12, were not suitable because of high disintegration of canned material. 'Prosperity' had green portions around the core and was therefore, unsuitable.

The colour of Meerti, Turi Alba, E.C. 8818, Tukon, Hybrid 12, Ogier and New Hampshire improved slightly after peeling, where as there was slight deterioration of colour in the varieties Prosperity, Market King and Best of all.

Effect of varieties on the yield and quality of canned tomato juice:

Twenty two varieties of tomatoes were tried and it was observed that the juice of varieties Pusa rubi, Vokal, Sanmarzano, Red Top and K-1019 had a deep tomato red colour after processing and storage. The yield of the juice was more than 75% from varieties Sioux, Marglobe, Early Chatham, Meotor, Poona-341, Early Canner, Tukon and Tip top. There was no bitterness in juice of any of the varieties. The metallic taste was more pronounced in the juice extracted by the cold break method than the hot break method.

2.2 Screening of varieties of peas for canning :

Thirty varieties of peas were tested for physico-chemical characteristics and canning quality, [illegible] of them in detail (Yales Early Crop, Bombay Green, Delhi Cape, Continental, Waranasi Sweet, Durantia, Khaperkheda, Blue Bentham, A. Wonder, K.Wonder, S.Supreme, P.Thomas Laxton, First to report, N.P.29 and Duke of Albany). Most of them were studied for 2-3 years. The rest of the varieties were studied only on a preliminary scale.

The yield of green pods (kg./acre) was highest in N.P.29 (1879), followed by Khaperkheda (1684), P.Thomas Laxton (1374); in the rest it was medium to low.

The yield of grains was highest in Khaperkheda (56%) followed by A. Wonder, P. Thomas Laxton, N.P.29, Delhi Cape, Blue Bentham, Bonville and Laxton Superb

(yield around 50%). The majority of the grains were of medium size. The percentage of big size grains was maximum in P. Thomas Laxcon(30-40) followed by K.Wonder (15-20) and Khaperkheda (8-12). The small size grains varied from 20-30 per cent in most of the varieties. The colour of the grains was deep green in Bombay green and green in Durantia, S. Supreme, N.P.29, Duke of Albany, Waranasi Sweet. Grains of the other varieties were creamy green.

On extended trials for 2-3 years, K.Wonder, Bombay Green, Yales Early Crop, S.Supreme, A. Wonder, were found good for canning. Continental, first to report, Blue Bentham and Khaperkheda were also satisfactory. The Varieties Bonville, Early perfection and Laxton Superb were found promising on one year trials. Delhi Cape, P.T. Laxton and N.P. 29, had un-attractive, bleached colour and considerable splitting and wrinkling after canning and were therefore unsuitable. Durantia had black eyed peas.

2.3 Influence of variety, maturity and some pre-drying treatments on the quality of dried peas:

Peas of different varieties, viz. P.T. Laxton, Delhi Cape, K. Wonder, A.Wonder, Khaper Khera, Blue Banthom N.P. 29, Waranasi Sweet, Duke of Albany, Morris, Bonneville and First to report picked in early and late seasons were assessed for their dehydration and rehydration properties after giving pre-drying chemical treatment of soaking in 2 per cent sodium carbonate solution followed by blanching in solution containing 0.1 per cent each of sodium bicarbonate and magnesium oxide. Peas of early season of Waranasi Sweet and Duke of Albany gave best results followed by Morris and Bonneville;

the coefficient of weight restoration on rehydration in these varieties being 1.0, 0.98, 0.96 and 0.93 respectively. Peas of late season suffered badly in rehydration properties. Out of the various other pre-drying treatments tried on P.T. Laxton, chemical treatment coupled with 10 per cent glucose or sucrose and given under vacuumised and pressure conditions improved the rehydration properties, rehydration ratio being increased to 1:3.0 from that of 1:2.0 in untreated and 1:2.6 in chemical treated peas.

3.0 POTATOES:

3.1 Investigations on the disintegration of the canned potatoes (Chhindwara Variety):-

Effect of maturity and specific gravity on the disintegration of canned potatoes were studied. Potatoes from a selected field; after 60,90 and 105 days growth were obtained. The specific gravity was determined by the brine floatation method. Potatoes were canned by the usual method in two lots. One containing 0.1% Calcium Chloride and one without it. It was observed that the specific gravity of potatoes was less than 1.076 at 60 days harvest and was more than 1.076 after 90 days and upto 75 days harvest no disintegration in canned potatoes was observed even in lot untreated with calcium chloride.

4.0 CUSTARD-APPLE

4.1 Investigation on utilization of custard-apple:

Physico-chemical characteristics of custard-apple were determined. The yield of pulp, peels and seeds was 44.5%, 41.4% and 10.9% respectively. The following products were prepared on Laboratory scale:

(1) Jam, (2) Canned pulp, (3) Squash, (4) Squash blended with pineapple and grape fruit juice,(5) juice.

Custard-apple contains a bitter precursor which on heating turns bitter hence cold pulp and squash made there-from did not turn bitter even after storage for a period of 3 months under ambient conditions. If the grit type material present in the pulp is removed the colour of the pulp becomes milky white. The squash prepared either from custard-apple alone or in combination with pineapple juice is highly acceptable.

5.0 CANNING OF VEGETABLES IN SAUCE:

The process for canning of peas and cauliflower in tomato sauce was standardized as it was observed that they remain uncooked in commercial processing [45 minutes at 11 lbs. pressure (240°F)]. The effect of pre-cooking and increase in processing time, were investigated and it was observed that peas canned in sauce could not be softened to the desired extent even after processing for 60 minutes at 15lbs. while cauliflower was cooked to the desired texture when processed for 45 min. at 12 lbs. Pre-cooking of the peas (5 minutes at 220°F) did not improve the quality of canned peas. It is possible that calcium present in tomato sauce may be responsible for hardening of the peas.

6.0 Studies on Chemical, Technological and storage of onions:

Three crops of red onions are produced in Nasik district during a year, namely - RANGDA(Sept.-Feb.), UNHALI or Rabi (Nov.-April) and POL or Khariff(June-Oct.).

Sampling of onions was begun 35 days after transplantation in Rangda and 60 days after transplantation in Unhali or Rabi and Pol crops. It was continued at fortnightly intervals till harvest. The bulbing index, number of scales (total and coloured) T.S.S., total

reducing sugars, colour, pungency and volatile oil increased till maturity (85-110 days) after transplantation. The moisture, pH, pectin, ash and density remained constant. Acidity decreased with progressive maturity (0.5 to 0.16%). N-53, variety used for POL crop showed the highest pungency and medium colour values. The Nasik Red variety traditionally obtained as UNHALI crop showed lesser pungency and colour values than N-53 in POL, but the highest sugar content. RANGDA which is a mixed variety showed the highest colour values.

The brix/acid ratio increased up to a period of 95 days during growth after transplantation in case of RANGDA, 105 days for UNHALI and 110 days for POL and then the curve tends to flatten when plotted against days. The brix/acid ratio can be considered as a more reliable criterion for determining the maturity of the crop for harvesting. As neck fall does not occur in case of RANGDA and POL crops, brix/acid ratio may be particularly useful for determining the harvesting time for these crops.

Onions as ascertained during survey are considered suitable for storage when the neck is tight and the outer scales become dry and rustle when handled. Eight different methods of curing were tried i.e. Traditional 2.5 cm. neck cut and traditional, crate method, Wind-row method, Leaf cover method (Natural) out leaves method, straw cover method and Bunch hanging method.

Leaf cover method and Bunch hanging methods were found optional for onions from three seasons from the point of development of its colour retention, pungency and reduction in wastage during storage.

The optimum loss of moisture at the end of curing period of 2 to 4 days was found to be 5 to 6 per cent.

Fifty Kgs. lot of cured onions have been stored in crates at the Model Store House, Pimpalgaon for 4 months (Rangda); 5 1/2 months, (Unhali) and 3 1/2 months (PO L).

Pre-harvest sprays with recommended doses of BAVISTIN CAPTAN, PLANTOMYCIN and MH-40 have been administered to control microbial decay and sprouting. Combinations of MH-40 with each of three fungicides were also tried. None of them were able to control decay/ sprouting on storage. Aspergillus (Species) was the most predominent pathogen observed during storage in the summer crop (70 to 80%). It was followed by Fusarium and to a small extent by Sclerotium species.

The air circulation in conventional store house (Chawls) is not adequate and so losses due to sprouting and rotting are heavy, specially during rainy season. There is a need to improve the storage structures such as by adopting Rack System for minimising the wastage due to sprouting and decay. Discussions were held with the NAFED Officials at Nasik for adoption of rack system for the storage of Onions. The design details for a Pilot scale Rack System were finalised in these meetings and accordingly NAFED built up such an Unit at Lasalgaon and carried out trials for storage in it for an year. Their findings paved the way for construction of a commercial rack system for storing about 1,500 M.T. of onions, measuring 117 meters (length), 21.5 meters (breadth) and 3.35 meters (height) shed at Lasalgaon. It has now started loading onions. This is a new development in the storage structure for storage of onions.

7.0 Utilization of Cannery Waste:

Experiments were carried out to prepare alcohol from a local Cannery Waste, (Mangoes and Oranges,) by selecting an effective strain of S. Cereveceai, obtained from CFTRI, was found to be the best.

Efforts were made to build up a culture of S. Cerevasai for fermentation of increasing quantities (5 ltrs.) of substrate, having T.S.S. 18°B.

The residue after fermentation was inoculated with C. Utilis for utilization of remaining solids like Pentoses, pectin, hemicelluloses etc. to increase its nitrogen content. The dried mass can then be used beneficially in the composition of animal feed. Experiments on utilization of orange and mango waste for the preparation of alcoholic product like CONTHRIP from oranges and preparation of biomass for animal feed purposes are in progress.

II. SNACK FOODS:

Development of Friction Type Cooker-cum-extruder and technology suitable both for Urban and rural sectors for manufacture of snack foods with protein enrighment based on local raw materials:

Composite flour blends consisting of Maida (8% gluten) potato/sweet potato flours, germinated Mung and millets as also defatted groundnut/soya flours were prepared. The extrusion qualities of these blends were improved by the addition of corn starch of specific grain size. The final product had a protein content of about 12 per cent. The different blends formulated were - (a) Maida, Corn Starch, groundnut/soya flour (2:2:1), (b) Corn starch, sweet potato, groundnut/soya flour (2:2:1), (c) Corn starch, potato and groundnut/soya flour (1:2:1), (d) rice flour and soya flour(7:3)

and (e) Maida (30 g.), Tapioca starch (100 g.) and germinated Mung (125 g.).

Toasting of selected blends was tried to obtain ready-to-eat products. Suitable blend for toasted product was that containing Maida, tapioca starch/corn starch and groundnut flour/soya flour (2:2:1). The optional moisture content of blend and its toasting temperatures were worked out. An Alcoholic extract of turmeric powder (up to pH 8.0)was suitable for substituting tartrazine used for colouring and commercially marketed product. Papad Khar has also been replaced with carbonate mixture.

A screw type vertical ccoker-cum-extruder based on friction principle has been designed to remove the deficiencies found in the same type of commercial machines. Thirty kgs. batch comprising of starch, Maida and defatted soya flour (2:2:1) was extruded through a friction type extruder in a local Unit and the product was found comparable to the commercial product in regard to composition, taste, texture, expansion and yield both by frying and toasting.

III. S P I C E S:

1.0 CHILLIES:

1.1 Sun-drying of chillies:

An improved method of sun-drying of red chillies on rack system has been developed. It consists of dipping the red chillies for five minutes in 'dipsol', draining and drying them on the rack system. The advantagesof the improved method of sun-drying of chillies are - (i) faster rates of drying (6 days as against 15-20 days in traditional method), (ii) more hygienic and sanitary, (iii) better retention of

quality characteristics (pungency and total colouring matter), (iv) economic benefit of Rs.20 to 50 per quintal.

1.2 Dehydration of chillies:

Dehydration of red and green chillies in cabinet as well as through flow dryers have been studied.

1.3 Fluidized Bed Dryer:

A bench scale fluidized characteristics, drying characteristics, heat and mass transfer rates and load effect pertaining to the red and green chillies in Fluidized Bed Dryer have been determined. The cost of Fluidized Bed Dryer have been determined. The cost of Fluidized Bed drying of red chillies has also been estimated. Fluidized bed drying of red chillies has been found to be economical due to higher heat transfer rates, simplicity of design, better quality retention and low capital investment. Trials on Fluidized bed drying of food commodities like, green peas, carrot dices, ladies-fingers, green coriander, garlic, ginger and orange peels have been carried out and Fluidized Bed Dryer has been found useful for these commodities also.

The P.D.R.U. committee in its 104th meeting recommended that the prototype Fluidized Bed Dryer developed at the Experiment Station may be shown to the interested parties, and any one wanting to copy the same should be allowed to do so. A number of parties have approached for design details of the Fluidized Bed Dryer.

1.4 Extension work

Demonstration of the improved process of sun-drying has been given at a number of places in the

chilli growing areas namely - Umred, Bhiwapur and Nagpur. The Process is being commercially adopted by a number of growers in the region. The process was also demonstrated at Srinagar, J & K, and has been found to be acceptable there.

IV. INFESTATION CONTROL OF FOOD GRAINS:

1.0 Extension work:

Demonstrations of the gunny bag pest proofing machine were carried out in collaboration with Shri. M.V.Sarangapani, Scientist, Discipline of I.C.& P. CFTRI, Mysore, at a number of places in Madhya Pradesh.

V. BAKERY TECHNOLOGY:

Samples of 31 varieties of wheat of National trials were collected from Inodre, [illegible] and supplied to Dr.S.R.Shurpalekar, Scientist, F.M. & B.T. Discipline, CFTRI, Mysore

VI. CONSULTANCY:

1. A techno-economic survey, of Vidarbha region for development of food processing industry was conducted on behalf of the Development Corporation of Vidarbha, Nagpur and the technical fee charges was Rs. 7,000/- plus T.A. and D.A. expenses of the team members. The potential for development of food processing industry in the region has been brought out and recommendations for setting up of new units and modernization of existing ones, depending upon the availability o f raw material and infrastructures etc. have been made to the corporation.

2. A survey of 4 districts of Madhya Pradesh for establishing food processing units was carried out by the Experiment Station and report submitted to M.P. Agro-Industries Development Corporation Ltd., Bhopal

on payment of Rs. 10,325/-.

3. A survey of gold finger industry was conducted in the region and based on the same a Research Project has been completed.

4. A detailed report pertaining to the survey of onion growing areas of Nasik, Yeola, Lasalgaon etc. was prepared and sent to the Institute. Based on its findings a R & D Project was drawn and investigations carried out.

5. A note on turmeric produced in Sangli district of Maharashtra was prepared. The note incorporates the information on trend and practices on the traditional methods of post-harvest ha ndling of turmeric. The survey also highlights the research problems that need attention.

VII. PROCESS/ES RELEASED [illegible]

Process	Party
1. Preparation of Waxol-o-12, (Through NRDC, fee charged @ Rs.2,500/- each party).	1. M/s.A.J.Chandak, Camp, Amravati(M.S.)
	2. Shri. Wadudeo Deshpande, Agriculturiest, WARUD, Distt. Amravathi.
	3. Shri. K.L.Lakhotia The Nook, Ramdaspeth, Nagpur.

2. Improved method for sundrying of chillies (Red)	1. M/s Luboil Industries, Great Nag Road, Nagpur.
	2. The vegetable Development Officer, Govt. of J & K., Lalmandi, Shrinagar.
	3. Shri Pradip Golchha, New Colony, Nagpur.
	4. Shri. R.C.Lakhotia, New Ramdaspeth, Nagpur-10.
	5. Shri. H.R. Mundhada, Utkhed, Amravati(M.S.)
	6. No. of other parties.

VIII. DEMONSTRATIONS:

i) Demonstration of the leaf cup making machine was given to Hon. Prime Minister and other Central and State Ministers at the Seminar/Exhibition held at Sewagram, Wardha. The Exhibition was sponsored by CSIR and organised by Centre of Science for Villages, Wardha. Demonstratiln for the visitors to Exhibition was given for about 4 days.

ii) Demonstration of the leaf cup making machine was also given at the Experiment Station premises to the following:- (a) Smt. Shanti Naik, Minister for Social Welfare, Govt. of Maharashtra during her visit to Mahila Arthik Vikas Mahamandal Ltd., Nagpur; (b) Shri. N.B. Mehta, Manager (R&D), Gujarat State Forest Development Corporation, Vadodara and (c) five other parties.

iii) Similar demonstration of leaf cup making machine was given at the Exhibition at Bhopal in the presence of Chief Minister of Madhya Pradesh as well as other VIPS. Demonstration was arranged for a period of about a month for visitors to the Exhibition. The Exhibition was organised by M.P. Agro Industries Development Corporation Ltd., Bhopal.

iv) Demonstration of the fluidized bed drying of parboiled paddy was given to Mr. R.K.Mehta, Ashok Mills, Nagpur.

v) Demonstration for the extraction of oil from orange peels was given to Mr. S.V.Velange, Production Officer, Corn Products (India) Ltd., Bombay.

vi) Demonstration of improved process of sun-drying of chillies was given to a number of parties, some of which are as follows:-

(1) Shri S.B. Gaidhane, Kuhi, Umred, Distt.Nagpur,

(2) Shri A.K. Bhiwapurkar, Paoni, Distt. Bhandara.

(3) Vegetable Development Officer, Govt. of J&K. Srinagar.

(4) Shri. G.S. Giradkar, Umred, Distt. Nagpur.

vii) Preparation of Gold Fingers: Demonstration of village/cottage scale technology developed for preparation of nutritious snack products like gold finger was given to the villagers at the Centre of Science for villages, Wardha.

viii) Hot water treatment of Mangoes: Demonstration of the hot water treatment of mangoes for reducing spoilage and accelerating the ripening was given to M/s. NOGA FACTORY, Nagpur.

IX. CURRENT R&D ACTIVITIES:

Work on the following R&D Projects is in progress:

a) Techno Economic Survey of Indian Traditional Foods.

b) Project No. 704: Study of Rice Production and processing system in Punjab, Haryana, Vidarbha and Andhra Pradesh its problems and solutions.

c) Project No. 706: Studies on production pattern and processing methodologies of common PULSES in Punjab and Haryana, Uttar Pradesh, M.P., Vidarbha Region of Maharashtra and Andhra Pradesh to identify main difficulties and initiate suitable remedial measures.

d) Project No. 707: Integrated soyabean processing and utilization:

Studies on Kali-Tur and development of balanced food supplements and beverages.

X. Products, processes etc. developed by theunit and released to Industry:

i) Improved process for the sun-drying of chillies
ii) Fungicidal treatment for control of fungal spoilage in Nagpur oranges after incorporation in the wax emulsion.
iii) An orange flavour emulsion for incorporation as flavouring agent in the manufacture of plain and carbonated orange beverages.
iv) Fluidized bed dryer for chillies and other foods.
v) Triple roller extractor - developed for extraction of orange oil from orange peels.
vi) Friction type Cooker-cum-extruder for manufacture of finger shaped snack foods.

vii) Lime Peel Oil Extraction Machine (Special type), for expressing of oil from whole fruits. The machine is working at M/s. Vidarbha Citrates at Nagpur.

viii) Hand operated improved extruder for use in rural development programme.

ix) Leaf cup cover and Bunch hanging methods of curing Nasik Red onions for better retention of colour and pungency as well as reducing wastage during storage for four months under ambient conditions.

x) Development of Tier Type Storage structure for Nasik Red Onions for retention of quality and minimising wastage during storage for a period of four months. On its basis a Two Tier Storage Structure to store 1,500 tonnes of Nasik Red Onions have been built at Lasalgaon in Nasik District. It has started functioning now on a commercial basis. The dimensions of the STORAGE STRUCTURE are - Length - 117 Meters; Breadth - 21.5 meters and Height - 3.35 meters.

XI. OUTSTANDING ACHIEVEMENTS:

(a) The Growers of Nagpur District faced the problem of drying of chillies in less than three weeks, The Zilla Parishad, Nagpur referred this problem to us to find out a quicker method of drying chillies with better quality retention and also to reduce the wastage. This problem was solved by us by evolving (i) improved method of sun-drying of chillies in a fluidized bed dryer. The improved method of sun drying of chillies has not only been taken up by chilli growers of Nagpur District but

also the Director of Agriculture, Govt. of J & K Srinagar, as well as growers in other parts of the country.

(b) The orange growers of this region suffered losses to the extent of 20-40 per cent in marketing oranges in Northern cities and Calcutta. The export of oranges was found to be a hazardous proposition due to heavy microbial spoilage. This problem was solved by (i) identification of the pathogens causing post-harvest storage spoilage. The principle pathogen was found to be Geotrichum candidum Link Var. Qitri auratti(Ferr). ii) wax coating of oranges by dipping in 6 per cent solution of waxol-o-12 containing 0.1 per cent Benlate-50 and 1000 ppm of Galixin for 20 seconds and drying them. This treatment was found to be most successful in minimising the fungal spoilage for a post harvest storage period of 20 days with good marketability. (iii) An improved package (wooden as well as cardboard carton) was designed and tested (iv) Carrying out commercial trials for marketing of treated fruits along with the untreated ones to establish the economic benefits. The process of preparation of waxol-o-12 has been released to three parties through NRDC and a number of growers have adopted the fungicidal wax treatment of oranges to minimise spoilage during marketing. Export of oranges has also taken flying start to middle East Countries.

(c) The utilization of culls posed a problem of disposal or obtaining economic returns. To solve this problem a Bench Scale Triple Roller Extractor has been designed and fabricated on the basis of the physico-chemical characteristics of Nagpur orange peels for the extraction of orange oil. Orange oil is a valuable

by-product and has a good market in the country. The droppings and culls were found to be a good source of raw material for the manufacture of pectin also. An orange flavour emulsion has also been developed for flavouring carbonated as well as plain beverage which has been released to a local factory.

(d) Two techno-economic surveys for establishing food processing units on the basis of availability of raw material, infrastructure and market potential were carried out.

(e) The leaf cover and the bunch hanging methods of curing of Nasik Red Onions have been adopted by the Associated Agricultural Development Foundation(AADF) in their onion farm and have also been extended through demonstration to the onion growers at Cinnar and Nasik. These methods have been introduced in the Benor Extension system operating in Nasik District.

(f) A 1,500 tonne capacity two Tier structure for storage of Unhali onions has been built by National Agricultural Co-operative Marketing Federation of India Ltd., in their shed at Lasalgaon in Nasik District and has started functioning commercially this year.

(g) A friction type Cooker-cum-extruder has been developed for preparation of snack foods and also a hand operated Extruder for rural sector. A standard formulation using local raw materials such as corn, maida and defatted soya flour (2:2:1) has been evolved to give 12% protein in the extruded snack food. In both types of Extruders care has been taken to remove defects in the traditional machines.

(h) A Proto-type of special lime oil Extractor from whole limes has been developed. This machine is working at a local Lime Processing Unit.

(i) Completed Consultancy work of developing a stable flavour base from Nagpur Orange Peel oil for the preparation of R.T.S. beverage from orange juice concentrate for MAIDC N OGA UNIT, Nagpur. The product is being commercially marketed by the firm. The party paid a sum of Rs. 10,000/- for this work.

(j) Fluidized bed drying plant (1 tonne/day) having a compartment system has been developed for drying of chillies and other foods. A coal heating system used for indirect heating of air in it has been provided. One such plant has been fabricated locally. It is expected to be installed soon. Two units are also in the offing in the chilli growing Umer district in the region.

XII. PAPERS PUBLISHED:

i) Effect of fungicides and other treatments on the post-harvest storage of Nagpur Mandrin Oranges ; M.S. Laul, S.D. Bhalerao, V.B.Dalal and B.L. Amla; Indian Food Packer, 1972, 26(3) 42-49.

ii) Studies on the sun-drying of red chillies (Capsicum annum Linn): M.S.Laul, S.D.Bhale rao, V.R.Rao, B.L.Amla; Indian Food Packer, 1970,24(2),22-28.

iii) Effect of fungicides and other treatments on Nagpur Santra Packed in ventilated wooden cases: M.S.Laul, S.D.Bhalerao, S.V.Ramakrishna, B.Anandaswamy and B.L.Amla, Indian Food Packer, 1976, 30(3), 31-36.

iv) Influence of variety, maturity and some pre-drying treatments on quality of dried peas; O.P.Beerh and Soma Kurian; Indian Food Packer 1976, 30(6),27-32.

v) Physico-chemical characteristics and canning trials of some varieties of Tomatoes grown in Central India: O.P.Beerh and V.R.Rane; Journal of Food Science and Technology, 1976, 13(3),151-155.

vi) Fluidized Bed drying of Chillies (Capsicum Annum Linn) : M.S.Laul and J.R.Giradkar, Developments in Drying, Editor, Dr.A.S. Majumdar, Science Press, October, 79.

vii) Studies on control of Sour rot in Nagpur Oranges (Citrus reticulata Blanco) : M.S. Laul, S.D.Bhalerao, G.V.Mulmuley; Jr. of Fd.Sci. and Technol, 1980, 17(278-280).

viii) Canning of Mandarin Orange Segments: O.P.Beerh and V.R. Rane. Indian Food Packer, Vol. XXXVII No.6, Nov-Dec. 1983 pp. 25-42.

2) PAPERS PRESENTED AT SEMINAR:

The papers presented at various Seminars/workshops, below:

i) Some technological aspects of Nagpur Santra; M.S. Laul and S.D.Bhalerao

Paper presented at Seminar on Citriculture held at Nagpur during November, 1972.

ii) Rice Milling: S.D. Bhalerao & M.S.Laul. Paper presented at Seminar on modernization of rice mills and utilization of by-products, held at Nagpur on 16th & 17th April, 1976

iii) Prospects and plans for agro-industrial development of Vidarbha Region, held at Amravati in October, 1976.

Paper presented "Salient features of Nagpur santra and its integrated utilization": M.S. Laul and S.D.Bhalerao

iv) Studies on chemical, technological and storage aspects of onions.

Paper presented at the National Workshop on Onions held at Nasik on 17th & 18th December, 1983. The workshop was organised by NAFED in collaboration with Ministry of Agric. Govt. of India.

The leaf cover and bunch hanging methods and Rack Type Storage structures were highlighted by the project Co-ordinator who was the Chairman of Session-III, on post harvest technology and processing.

3) . PAPERS SUBMITTED FOR PUBLICATION: (In Indian Food Pkr.).

1. "Curing and Storage of Nasik Red Onions (Allium Cepa L.)"

   Laul M.S., Bhalerao S.D., Mulmuley G.V., Shah G.R., and Dalal V.B.

2. "Studies on the preparation of extruded finger shaped snack food with protein enrichment".

   Laul M.S., Bhalerao S.D. and Mulmuley G.V.

XIII. SUPPLY OF PRODUCTS:

Product	Quantity	Amount
1. Waxol-o-12	3,016 Ltrs	Rs.33,186.04
2. Dipsol	1,962.5 Ltrs	Rs.14,718.75

XIV. AWARDS, HONOURS & DEGREES:

The following staff of the experiment station have been awarded the degree of Doctor of Philosophy, by the Nagpur University, during the years shown against each:

Name	Year
1. Dr.M.S.Laul	1976
2. Dr. S.D.Bhalerao	1976
3. Dr.G.V.Mulmuley	1984

XV. ANALYSIS AND TESTING:

A total of Eighty five samples of food products were analysed and a fees of Rs.2,290-00 charged as per approved rates.

XVI. Technical Enquiries.

A total of seven hundred and fifty technical enquiries received from the various Food Processing Industries, entrepreneurs etc. were attended to.

XVIII. TECHNICAL ASSISTANCE:

One hundred and ten parties were given technical Assistance on the various problems in food science and technology.

XVIII SUPPY OF BLUE PRINTS/DRAWINGS/DESIGNS ETC:

Blue prints/drawings of Fluidized Bed Dryer, Friction Cooker-cum-extruder and Leaf Cup making Machine were supplied to 16 parties.

XIX. DEMONSTRATIONS:

A total of 30 demonstrations pertaining to the Leaf cup making Machine, Fluidized Bed Dryer and orange peel oil extractor, developed by the Experiment Station were given to the parties.